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A NEW TYPE OF BATTLESHIP.

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It is proverbial in our naval service that when an officer is given a vessel to prepare for war, with the idea of fighting her himself, he gets on board as heavy a battery as he can, with as many long range guns as he can obtain, and improvises protection to vital parts with whatever may be available, his limit being whatever he has time to prepare, or whatever will reduce the stability to the lowest safe limit. From our colonial days to the present time, the American has gloried in his heavy batteries and his long range guns.

To-day, though war is not imminent and we more than ever desire international peace and the good will of other powers, we do not forget the important end for which our ships and our men are prepared, and we must be no more careless—indeed we must be more careful—in regard to their preparation, than if they were intended for immediate conflict.

Personal interest can never be wholly replaced by anything else. No one can ever feel the jealous interest in the efficiency of a vessel that her commander does. It is not practicable, nor

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would it be wise, to place the design of our vessels entirely in the hands of the men who are to command them; yet no other person will give the subject such earnest and enthusiastic attention, and in some matters no other is, or can be, so well qualified to decide.

Of the unusually free discussion of the battleship problem that has been going on during the past year, the most noticeable results are the restoration of the superposed turret for the five battleships just laid down and the retention of the 8-inch gun for future vessels.

A result of not less importance is the extension of intelligent interest in the subject, with the accompanying crystallization of service opinion.

The subject has become a more open one, and notwithstanding the marked ability of the men upon whom rests the responsibility for the designs we are likely to gain thereby. It usually happens that a spread of general interest and enthusiasm is followed by pronounced development. The radical ideas of more or less irresponsible persons frequently become of general use after they have been thrashed out in discussion, and perhaps modified. Those that are weak are more likely to disappear than the better ones, and those that are sound are rather more likely than not to prevail.

We have not stopped in the development of our naval power, and, until we do, the design of the battleship remains as full of interest and importance as ever. Indeed, while our good European friends are displaying such frantic haste in their naval evolution, and England, because of the unusually heavy demands on her purse for other expenses, is unable to keep pace with them, it is important, it is even imperative, that we assume the duty of maintaining the balance of power; and it is particularly fortunate that we find present conditions so favorable.

Let any European power, or a coalition with really common interests, attain an unquestionable supremacy over its rivals, and we will find that among nations there is a supreme indifference to another's idea of his own rights. We have, among nations, unusually deep-seated convictions as to our rights, and, especially of late years, we have shown a readiness to defend them. I mistake the spirit of the American people if they do not go forward with the development of the power upon which the defense of our rights and our prosperity primarily depends.

Our steel navy is not old, and we are gaining valuable experience with it each year. It were shameful if there should not be material improvement in every new design, and unfortunate if any means for real improvement were neglected. The Naval Institute seems to offer the most valuable means for service discussions, and it would be conducive to increased influence if the criticism of the various papers published were more general and more rigorous. Adverse criticism seldom finds its way to the place where it can do the most good. "Everybody is wiser than anybody," and the more opinions are carefully presented, the greater the chance of the final movement being in the right direction.

A PROPOSED TYPE OF BATTLESHIP.

While I outline a battleship design, it must not be understood that it is intended as a working design, for that is beyond my power. It represents instead, *features* of design, united as one general design for clearness. The various features are to a certain extent interdependent, but most of them can be applied in principle to designs in general. Only men of especial training and long experience can work out the details of a design and say definitely what features may, and what may not, be united in a single type, or, in a general plan, what modifications are necessary to make the plan practicable.

In the design proposed it has been attempted to provide a sufficient coal capacity for work that is usually relegated to armored cruisers. While we cannot do without the very heavy cruiser, it seems unfortunate; and we shall lose nothing if we can readily adapt the battleship to some of the cruiser's work.

Nothing but an armored vessel or a very small one (*e. g.* a submarine), can push reconnaissance home to the point where definite information can be had. The armored cruiser can hope to escape by her reliable high speed in a seaway. I have endeavored to outline a battleship that can receive a fairly heavy fire without endangering seriously her power of retreat. It should be remembered that in the ordinary conditions of sea a vessel with unarmored or lightly armored bow, pursuing at high speed, will receive sufficient punishment forward between wind and water to make her give up the chase, so that it is by no means certain that the armored cruiser will be able to capture

6"
14"
8"
18"
3"
6"
4 1-pdr
auto
14"
3"
8"
6"
4"
13"
3"
10"
4 3"
5" 60 cals
13"
3"

smaller cruisers when the latter wish to escape. The former can make "reconnaissances in force," but are not suitable when opposed by battleships, for they cannot press near enough to get definite information without risking serious bow injury, which implies loss of speed and capture. The proposed type can; and one vessel, assisted by a flotilla of destroyers or other fast vessels, could accomplish more in reconnaissance than half a dozen armored cruisers, besides offering better protection to weaker vessels that may be in company. The one great advantage of the heavy armored cruiser is speed; yet except in emergencies their high speed is not available, since it involves greater coal expenditure than a squadron with ordinary coaling facilities can afford. The large ocean ferries can steam continuously at full speed, for they are sure of coal when they need it; but no fast cruiser can maintain a very high speed for a week without recoaling; and the problem of recoaling is not a simple one. The battleship with a good coal supply and fair steaming qualities can do most of the armored cruiser's work: the latter cannot, however, take the other's place.

We must have *some* fast seaworthy vessels; we cannot combine great speed and heavy batteries and armor. Since among fast vessels the weaker may prevent the stronger from overtaking her, two 7000-ton cruisers should be more valuable in a fleet than one of 14,000 tons.

Some believe that we must build very large cruisers because other nations do. That is not an evident reason. The battleships can do part of the armored cruiser work and smaller vessels can do the rest; then, when it comes to a fleet engagement, we shall be stronger than if more of our men and money had been put into cruisers.

THE BATTLESHIP PROPOSED.

Displacement, with all ammunition, stores and water, and 1000 tons coal, 15,975; draft, 26.5′.

With 2500 tons coal, 17,475 tons and 28.5′.

Length 400′, beam 80′; armored freeboard, fd. 17 feet, amids. 15′, aft 16′.

Speed, 4 hours, 18 knots, with 18,000 H. P.; sustained sea speed, 16 knots, with 11,500 H. P.

Endurance at 16 knots, over 3000 miles.

THE ARMAMENT AND ITS PROTECTION.

Number.	Caliber.	Length in cals.	Normal penetration at 4000 yds. (capped.)	Muzzle velocity.	Protection.	Arc of train.	Height.	Ammunition, rounds.	Weights. Projectile, lbs.	Guns and Mounts, tons.	Ammunition, tons.	Protection, tons.	Total, tons.
6	13	40	20.7″	2800	18″	{300 / 315}	{24 / 22}	720	1100	633	585	949	2167
6	10	40	13.6	2800	18	180	22	600	500	345	300	512	1067
12	5	60	7.	2461	6	125	12	1800	100	84	129	36	249
16	3	50	1.5	2524	....	{150 / 240}	{13 / 45}	2400	16	40	30	....	70
	Other guns and torpedoes									12	50	....	62
40		Total								1114	994	1497	3605
					Alternative, in place of twelve 5″ guns:								
18	4	60	5.	2540	6	128	12	3125	52	92	110	47	249

The full supply of ammunition to be carried on normal draft.

Hull armor.—Completely armored side, average width 22 feet. Thickness 6″ for an average width of 13 feet, with a belt at the water line of 8″ armor, to taper in the last three feet of its depth to 5″. Protective deck 1½″ amidships and 2½″ inclined at the sides. Main deck, 1½″ (covered with wood). Cellulose, if used, to be allowed for by a reduction in the weight of armor.

Battery protection.—Turrets, 14″ inclined at 45° in front, 8″ sides, 4″ rear, 3″ top. Barbettes, cylinders 18″ thickness, 31½ and 22½ feet, external diameter, on supports of same diameter, resting on protective deck. Thickness of supports 3″ to 8″; average, 6″ and 4¾″ respectively. Weight of turrets, barbettes and barbette supports, including bolts and backing and all framing contained in them, 474 tons for each 13″, and 256 tons for each 10″, gun position. Provision to be made for supplying the forward turret from the after magazine and the starboard turret from the port one, and *vice versa*.

Conning tower to be a cylinder of 9 feet external diameter, 12″ thick, with supporting cylinder of same diameter and 3″ thickness resting on the main deck. Tube, 30″ internal diameter, 6″ thick above main deck and 4″ thick below, resting on the protective deck. Weight, 66 tons. Tower aft, for signal control and for steering in case of injury to the forward gear, 4½

feet external diameter, 6″ thick, on support of same diameter, 1″ thick, resting on main deck; tube 6″ internal diameter, 2″ to 3″ thickness. Weight of both towers, with fittings, 79 tons.

The 5″ guns and the after 3″ guns to be protected by circular shields training with the guns, so that the port remains closed when the gun is trained, as is the practice abroad; the shields to taper from 6″ to 3″ in thickness. The mount to be a modification of the Krupp type, described in the Naval Intelligence Office Annual for 1900, pp. 140-141. Gun and shield to be readily dismounted and housed, thus admitting light and air, and the side to be free from projecting sponsons.

The outside plating on the bow to be much inclined; that on the stern, slightly so.

The after side of the forward barbette to be slightly reduced in thickness; the support underneath, being screened from normal impact, to be reduced to 3″ thickness; on the forward side, protected by the inclined bow armor, the thickness to be 5″, the remainder to be 6″ to 8″ thickness. The after barbette and support to be similar.

The outboard sides of the 10″ barbette supports to be 6″ to 8″ thickness, the inboard sides 5″, and the forward and after sides to be 3″ to 4″ thickness.

The extension of armor to the ends, with the preclusion of air ports, makes it especially important that the ventilating system be efficient, having in view protracted service in the tropics. It is not thought necessary, however, to have any of the principal bulkheads pierced for ventilating ducts.

Reserve coal to be carried below the armor, outboard of the magazines.

Area of water line 25,820 sq. ft., coefficient, .8069; tons per inch, 61.25; depth of C. B. 11.6′; B. M. 19.22′; C. G. above W. L. about 2′, metacentric height about 5.6′; block coefficient, .6595.

In comparing with other designs it should be remembered that "normal displacement" usually refers to trial trip, rather than service, conditions: for example, the vessels of the Virginia class are to carry but 408 tons of ammunition at normal displacement.

SYNOPSIS OF WEIGHTS.

	TONS
Hull, steel	4000
Armor decks, main and protective	1600
Hull, wood	140
Hull fittings	720
Outfit, masts, ladders, furniture	100
Equipment	125
Electrical	150
Boats	25
Officers, men and effects	110
Stores	200
Fresh water for drinking	50
Armor, side, with bolts and backing	2431
Armor, battery, with bolts and backing and framing.	1497
Conning tower, supports, and tubes	79
Ordnance	1114
Ammunition	994
Engineer's weights, including water	1640
Coal	1000
Displacement, normal	15,975
" maximum	17,475

SPECIAL FEATURES.

Perhaps the most important innovation proposed is the reduction in the number of heavy gun positions and the corresponding improvement in the protection afforded them and in their availability on any particular occasion,—technically, in their arcs of fire.

The superposed turret gave a manifest superiority to guns so mounted over those on the side. A more rational means to obtain such advantage is to add a third large gun to each of the principal turrets, one large gun being of more value to a battleship than a pair of 8". The target presented by the turret is then smaller, and it can, with the same weight, be given more adequate armor protection. It is decidedly less vulnerable. A third gain is the lowering of the very heavy weight under consideration. These radical advantages offset any possible advantage the superposed turret may have.

Having decided upon two principal turrets with three large guns each, the next question is the secondary turrets. The service has declared itself of the opinion that something more

powerful than the seven-inch gun is required, and, as I understand it, it must be 8″ or heavier.

In a battleship of 16,000 tons, which is about as large as it seems worth while building under the present limitations as to draft of water, we can take two turrets of two 12″ guns each, two of three 10″ guns each, or four of three 8″ each. In the last case we reduce the arcs of train of both main and secondary turrets considerably, and the armor protection must be inadequate. Accepting two broadside turrets, of two 12″ or three 10″ guns each, we can give them arcs of fire of 180°,—a full broadside train,—while the forward turret can fire through an arc of 300°, and the after one 315°,—from two points off the bow to the stern. At extreme train it would probably not be advisable to fire the gun nearest the other turrets, but the other two could be fired at these extreme positions. For an arc of 127° on each broadside both the principal turrets would be available. The importance of this advantage in a fleet engagement is supreme. The necessary conditions are that there be but four heavy gun positions and that the end turrets be placed as far apart as possible.

Three 10″ guns in a beam turret seem to me preferable to two 12″, and the weight is somewhat less. The problem may then be resolved into this form: shall we have four turrets mounting three 12″ guns each, or two mounting 13″ and the others 10″. In squadron engagements both end turrets will be in action most of the time, both beam turrets rarely. It would seem wise to put the greater strength where it will be best available. The problem of mounting two turrets for three 12″ abreast is a very serious one, or indeed that of mounting them on the beam at all. The 10″ will penetrate nearly all armor afloat up to 4000 yards range, the impact being within 30° of the normal, and the 13″ is decidedly better than the 12″ for carrying heavy bursting charges through armor. I am strongly of the opinion that the battery should be six 13″ and six 10″.

The extension of the use of 6″ armor on the hulls of foreign vessels, and the consequent reduction of the thickness of armor on heavy gun positions and water line, makes the 8″ and smaller calibers less valuable, and invites us to replace them by more suitable guns, or to change the form of projectile so that the muzzle energy will be less affected by the resistance of the air.

At present they cannot do the work required. The eight-inch is not powerful enough for the penetration of the heavy gun positions or water line armor, or for the explosion of shell behind the six-inch armor that in recent types covers such large and important areas. Normal impact is the abnormal case, and the gun should have power enough to make every shot count that strikes within say 30° or 40° of the normal.

The battery proposed contains twelve armor piercing guns, of which in squadron action nine will almost always be available, and in certain situations all twelve. The same cannot be said of any present type.

To those who object to the dangerous chance of three guns being disabled by one shot, let us say: Take this and any existing or proposed type and compare them. In this, the gun positions being more thickly armored and affording in the aggregate a much smaller target, there is decidedly less chance of a turret being put out of action. Let us assume, however, that one turret of each type is disabled,—which vessel retains the advantage? The answer, I think, must be: The one that retains nine well protected guns capable of piercing the other's heavy gun positions, smashing her water line, and bursting shell inside her battery decks,—and this for a squadron action or for a duel.

RELATIVE INACCURACY.

For flatness of trajectory the 6″ gun is nearly as good as the 10″ up to 2500 yards. At 6000 yards, however, the vertical error due to an error of 500 yards in setting the sight, is 80 feet for the 6″, 57 feet for the 10″, and 49 feet for the 13″, which would make considerable difference in the number of hits. 4500 yards is about the range of the 6″ when accuracy is considered, the vertical error due to an error of 300 yards in estimating range being 26 feet.

It may be remarked that we have at sea no such accurate means for measuring range. The accompanying table is based upon ideal conditions. Errors of the gun and the gun captain, delay or errors in communicating ranges and setting sights, the error due to rolling, the important variation in the conditions affecting the muzzle velocity and the resistance of the air,—all these are neglected. The table represents the vertical

error of the gun at different ranges due to the insurmountable error in measuring ranges.

It is assumed that a horizontal base range finder is adopted, such as the Fiske Turret Range Finder, with the necessary auxiliary instruments for use when rolling, and that the necessary probable error due to concussion, incorrect adjustment, wear and tear, and errors of observation, is 30″ for a base of 30 feet, or 5″ for a base of five feet, which allowance probably represents a condition not yet attained. This would give a probable error of 58 yards in 2000, or 232 in 4000. We have at present no means of estimating range with one-half this accuracy, under battle conditions. A fair instance of the actual conditions may be referred to, when target practice at unusually long range was attempted, and the target was not struck.

The accuracy of the large guns has been questioned, but the reason has been generally overlooked. In our earlier turret mounts the control mechanism was awkward and the gun pointer was expected to train the turret, elevate both guns, attend to a certain extent to the loading, and fire both guns. Under such conditions the guns cannot be worked to advantage. A man cannot fire a gun accurately and attend to anything else at the same time.

In any gun too large for shoulder pointing one man is required to keep the gun trained on the target, another to elevate and fire, a third to observe the effect of fire, supervise the adjustment of sights, indicate the target, superintend the working of the piece and the supply of ammunition and control the crew. By this or similar division of duties, and by such means alone, can real efficiency of fire be attained. The fewer the gun positions, the better trained can be the gun pointers and gun crews, the more simple the transmission of orders and instructions, and the more effective the control of fire by the commander.

At short ranges it may be desired to fire all the guns of a turret together for smashing effect. There is no vessel that could withstand such punishment.

A three gun turret should have two officers; one in the training hood, in command, who may or may not operate the range finder or the training mechanism; the other a trained warrant or junior officer to superintend the working of the guns. There should be three sighting hoods for the gun pointers, who have but to elevate and fire.

The loading should be as far as possible automatic, the power being retained in springs compressed by the recoil of the gun, although alternative power must be constantly available. The opening and closing of the breech must be automatic, and the more complete the automatic mechanism for loading, the less will be the time wasted and the greater the rapidity of fire. The British have succeeded in firing their 12″ gun at intervals of 30 seconds; with automatic mechanism this interval should be the usual one, instead of a phenomenal one. Machines do not waste time, and they can be made reliable and certain of action, though they are not always satisfactory when first used.

THE CAP.

I do not mean that the guns should be fired with such rapidity constantly or usually,—but that the time should be taken for necessary sighting rather than wasted in loading;—and in the transcendent moment when a tactical advantage has been gained and several vessels, or all of one squadron, are able to deliver their fire at short range, the more reliable speed of automatic loading will insure decisive results. Now-a-days vessels have so much greater mobility than formerly that a tactical advantage is not so decisive unless the fire be vitally destructive,—for a position of tactical advantage cannot long be maintained.

The typical example of "the cap" illustrates the decisive advantages of large arcs of fire and the ability to keep up rapid fire for several minutes. It also shows a position where heavy armor on gun positions would be appreciated and where simultaneous fire from three guns would prove decisive. With automatic loading little time would be lost in waiting for a slow one to load.

Though the typical cap be impracticable until we have abandoned the use of smoky powder, and may even then remain an ideal condition, yet the actual tactical advantages that may be gained will be more striking rather than less, for the longer and more irregular the line of battle the more effective the concentration when you get it; and the more smoke there is to conceal the enemy's exact position, the more difficult it is to avoid being "capped," and the more important is short range to accuracy of fire,—therefore the more important is the power of extremely rapid fire.

TYPICAL SERVICE GUNS (MODELS OF 1899). PENETRATION OF KRUPP ARMOR WITH CAPPED PROJECTILES. VERTICAL ERRORS DUE TO THE IMPOSSIBILITY OF ACCURATELY MEASURING RANGE.

Caliber, inches..	1.85" V. M.	3"	4"	6"	10"	None in service. 13"
Length in cals..	Semi-auto.	50	50	50	40	40
Wt. of projectile, lbs.....	3	13	32	100	500	1100
Muzzle velocity, f. s.....	2200	2900	2900	2900	2800	2800

Range.	Error in estimating range, yards.	Pen., ins.	Vertical error, feet.	Pen., ins.	Vertical error, feet.	Pen., ins.	Vertical error, feet.	Pen., ins.	Vertical error, feet.	Pen., ins.	Vertical error, feet.	Pen., ins.	Vertical error, feet.
1000	14	..	..	3.1	...	5.1	...	8.7	...	18.3	...	26.0	...
1500	32	..	2	2.6	1	4.5	1	8.0	1	17.4	...	25.0	...
2000	58	..	5	2.2	3	4.0	1	7.3	1	16.5	...	24.1	...
2500	91	..	14	1.9	6	3.5	3	6.7	3	15.7	3	23.2	3
3000	130	..	24	1.6	12	3.1	6	6.1	6	15.0	5	22.4	4
3500	178	..	46	1.4	22	2.8	11	5.6	10	14.3	9	21.5	8
4000	232	..	78	1.2	38	2.5	19	5.1	16	13.6	14	20.7	12
4500	294	..	..	1.2	60	2.2	30	4.7	26	12.9	19	19.9	17
5000	362	..	..	1.1	161	2.0	48	4.3	40	12.3	28	19.2	25
6000	524	..	..	....	231	1.8	108	3.6	80	11.1	57	17.8	49
7000	712	..	..	....	....	....	255	3.2	157	10.1	102	16.5	83
8000	931	..	..	....	....	....	....	2.9	283	9.2	167	15.3	137
9000	1179	..	..	....	....	....	....	....	....	....	280	14.2	211
10000	1454	..	..	....	....	....	....	....	....	....	....	13.1	309

The Chief of the Bureau of Ordnance, in his last Annual Report, intimates that heavier projectiles will be adopted.

The turret trainer should keep the firing circuits closed when the train is correct. The gun pointer should have a spring switch, which he should close whenever the gun is correctly pointed. The breech closing being automatic, the gun should be ready for instant firing when the closing of the breech is completed. There may also be a switch near the rear of gun where the circuit may be broken whenever for any reason the gun should not be fired. The turrets proposed are large enough to admit a very long recoil, with a view to saving the energy for the automatic loading.

There are many machines in profitable use to-day where more complicated work is performed automatically with certainty of action and high speed. Such machines are not perfected in a day or a year; but it does not seem unreasonable to suppose that the mechanism could be developed in the time needed to construct a battleship.

RAPID FIRE GUNS.

With a 6″ armor coat, we might neglect the fire of the enemy's light guns, providing no especial guns to oppose them; but the torpedo and the torpedo-boat are being developed as rapidly as ever, and are worthy of our most careful attention.

The Whitehead torpedo has now a speed of 20 knots for 2000 yards, and makes fairly reliable runs for 1500 yards at a much higher speed. It is important that we have guns suitable for stopping a torpedo-boat outside the 2000 yards range. Let us see how much hitting is necessary.

The most reliable data are furnished in the case of the Winslow. This boat engaged a masked battery using smokeless powder, the guns being field pieces of about 3″ caliber. Shells exploded in both conning towers (disabling both steering gears), in one boiler (bursting over a hundred tubes), in one of the main engine cylinders, and in the cabin (setting it on fire). Many shells striking stanchions, ventilators, smoke stack, &c., exploded. A piece was torn out of the warhead of a torpedo. The captain and several of the crew were wounded, and the other officer and four men of the crew were killed, the casualties amounting to 33 per cent.

Had the relieving tackles functioned properly, the boat could

have hauled out of action (for she kept one engine in operation), or, if the attack had been upon a battleship, she might have kept on, which in ordinary torpedo attack is the safest thing to do under such circumstances.

The fact is, that she was hit in many vital points, the projectiles exploding with great effect, and that she was not entirely disabled. She returned to Key West under her own steam, after being towed out of action and patched up.

If we would insure the stopping of a boat, we must hit her with shell carrying enough explosive to produce great structural injury. It is idle to expect to hit enough vital parts with small projectiles. The boats can fly with one wing. They have two heads, duplicate hearts, lungs, &c., and more than one weapon. To begin with, we need to have weapons that will be accurate at ranges exceeding 2000 yards, when the range is not definitely known. The alternative is to keep the sights of certain guns set at definite ranges. But it is preferable to abandon the use of guns that do not have flat trajectories for considerable range. A glance at the table will show that the present 3-pdr. is practically useless beyond 2000 yards and the 3″ is not satisfactory. By increasing the weight of the 3″ projectile to about 16 lbs., however, better results can be attained.

We may feel satisfied that a larger shell is required to stop a torpedo boat, but the problem of mounting a larger gun on high bridges or platforms is so difficult that we will find it necessary to adopt the 3″ for a part, at least, of our torpedo boat defense. The necessity for guns mounted high is emphasized by the successful development of the submarine boat. Vessels of this type, while they may seek cover under water, will usually operate in the awash condition, and guns to hit them should be mounted high. The 3-pdr. and 6-pdr., especially the low velocity weapons, cannot get the range accurately enough to hit them. The automatic 1-pdr. directed like a hose, is an effective weapon; but it must be remembered that great skill is required to play a hose upon a small spot, perhaps a mile away, especially from a rolling platform.

To settle these questions, or, rather, to gain information upon which a decision may be based, the following exercise is proposed.

Construct rafts carrying cylindrical, muslin-covered frames,

backed by wire of 2″ mesh, the size and color of the target to represent the bow view of torpedo boats of different classes.

Anchor these targets in some little-frequented place, and take means to warn approaching vessels. Then at night let a battleship (or other vessel) approach from some distance at speed, having a small anchor and buoy ready for slipping at the stern. When she sights one of the targets, let her open fire at it, slipping the buoy at the same time, and keeping up full speed. At the end of a definite interval, say three minutes, if the distance be over 3000 yards, or two minutes, if less, let her cease firing or attack another target, a buoy being always dropped to mark the opening range. Next day, the number and character of the hits can be investigated. It is believed that the target representing the submarine boat awash will not usually be sighted at a sufficient range, or hit with sufficient certainty; also that after sighting one target and opening fire great difficulty will be experienced in seeing others that may be in the vicinity.

PROPOSED NEW MODELS OF RAPID FIRE GUNS AND PENETRATION OF KRUPP ARMOR (CAPPED PROJECTILES).

Formula (Bureau of Ordnance). $V = \dfrac{d^{1\frac{1}{2}} p^{\frac{1}{2}}}{w^{\frac{1}{2}}} K$, which, for any particular projectile, may be converted into the form $p = bv^2$; where $b = .000085822\left(\dfrac{w}{d}\right)^{\frac{4}{3}}$. v is the striking velocity in f. s., w is the weight in pounds; d is the caliber in inches.

Caliber, inches	4	4	5
Length, calibers	60	60	60
Wt. of projectile	48	32	100
Muzzle Velocity	2644	2540	2461
Log b	6.60809	6.62981	6.74674
	−10	−10	−10
Range, 1000 yds	6.5	6.6	8.6
1500 "	6.0	6.1	8.0
2000 "	5.5	5.7	7.5
2500 "	5.1	5.3	7.1
3000 "	4.7	4.9	6.7
3500 "	4.3	4.5	6.3
4000 "	4.0	4.2	5.9
4500 "	3.7	3.9	5.6
5000 "	3.4	3.6	5.2
6000 "	2.9	3.1	4.6
7000 "	2.6	2.8	4.1
8000 "		2.5	3.7
9000 "		2.3	3.4
10000 "		2.2	3.2

The writer is of the opinion that the penetrations given in this table for 2500 yards, can, with an improved form of projectile, be obtained at 4000 yards or more. If by the improvement in form the resistance of the air at high velocities can be reduced one-half, the penetrations given for 2500 yards should be attained for 5000. The trajectories, also, would be as satisfactory as that of the present 10″.

With systematic variations of this exercise we can gain much valuable information. If, regarding the submarine boat as a scarecrow, we make no endeavor to provide defense against it, we shall be morally and actually responsible to the country for any disaster we may encounter through that agency.

Without more definite information upon which to base opinion, we can say that the 4″ gun of 60 cals. firing a long, heavy projectile, seems the most suitable for torpedo boat defense; our type can carry eighteen such guns on the gun deck, protected by six inch armor. The muzzle velocity with a 52 lb. projectile should be 2540 f. s., and the penetration of modern armor at 4000 yards, normal impact, about 5″, using a projectile of special form.

The superiority of eighteen 4″ over twelve 5″ of similar type, is not so great as to prevent consideration of the latter. If, as I believe, a penetration of 7 inches modern armor at 4000 yards can be attained with a 5-inch gun suitable for mounting on shipboard, then I prefer the twelve 5″.

Many years ago extensive experiments with projectiles of different forms developed the fact that the ogival projectile of present use experienced about half as much air resistance as a similar one of flat head. The spheroidal head of one caliber was found equivalent to the ogival, and the projectile having a spheroidal head and taper rear, with a length of three to four calibers, was found to be superior to all others. Quoting Sir J. Whitworth, "No alteration of this form can be made without producing an inferior result." He also said, and it has been found generally true, that the flat base "is a better form for shell, as the projectile holds a greater bursting charge of powder."

Bashforth, from whom we take most of our data concerning the resistance of the air, says that at very high velocities the effect of the form of projectile is greater. Velocities high in his day are very low velocities to-day, and I think that the form of projectile best suited for armor piercing shell is important enough to receive thorough investigation at once.

If tapering the base is as effective as changing the form of head, then we should get a penetration at 4000 yards with the proposed 5″ gun of 60 calibers of 7.5-inches modern armor. If it produce no material effect, we should get 7.5 "penetration at 2000 yards, using a projectile weighing 100 lbs."

If we get the center of gravity of the shell abaft the center of lateral resistance, we shall reduce the tendency to tumble and may actually overcome the drift of the projectile to leeward.

If we desire to use flat-base shell with large bursting charges against torpedo boats, and tapered-rear armor piercing shell against battleships, we can make sights adapted to both kinds of amr unition. But this would not be advisable for guns of less than 4″ or more than 6″ caliber,—and of doubtful advantage for the 6″.

PROTECTION.

The weight assignable to armor and its supports being limited, the most careful economy is required, and *internal* armor should be reduced to a minimum. Where armor may contribute to the structural strength, it should do so; in this respect the two complete armor decks are important, and the bow armor stiffens the ram. In general, the 6″ and 8″ armor can be worked in larger plates than thicker armor, and this is an important item. The use of 6″ armor on large areas has inevitably followed the extension of rapid fire mechanism to larger guns and the development of the high explosive shell. Heavy transverse or diagonal bulkheads are no longer advisable; they might better be applied to the outside, particularly at the bow, which will bear the brunt of the fire in the first part of an engagement, when "bow presentment" is particularly advantageous to a squadron of well protected vessels.

With bow presentment, the hull being protected by 6″ side armor inclined at 45°, with 8″ armor at the water line, few projectiles will get through, normal impact being impracticable. The fire at three points off the bow is the full broadside, six 13″, three 10″, six 5″, and at least ten 3″. *Compare with vessels having unarmored bows* and internal diagonal armor.

The 3″ guns are much exposed, but that is so in all types, and they are where they will be most available in case of torpedo attack. If it be advisable to withdraw the crews temporarily, armored positions are at hand where they can await orders.

The protection afforded to other guns is unprecedented. The battery being better adapted for disabling an enemy's guns, a vessel of this type should be less vulnerable to torpedo attack at the close of an engagement, than an adversary of equal strength.

Looking abroad, we find usually four 12″ guns, and a number of 6″ and smaller calibers,—none being supposed as powerful as our new model guns of similar caliber. None of their 12″ guns are markedly superior to our new 10″, and few are equal. There are few guns now mounted in foreign ships that could penetrate the proposed heavy gun positions or the barbette supports. The foreign six-inch guns, if we can believe the reports, are unable to penetrate the six-inch armor at ordinary ranges; but we must look to the immediate future as well as the present. It is practically certain that a few years hence more guns capable of penetrating six-inch armor will be carried,—we may then be forced to build vessels of low freeboard.

Considering the fact that only large projectiles, and few of them, will penetrate the 8-inch armor at the water line, the use of cellulose is not considered so advantageous as a careful disposition for closing shot holes. The Colomé leak stopper seems effective.

THE FORM OF HULL.

A rather full water line is proposed, with correspondingly fine vertical sections. The bow underwater is a modified ellipsoid, and offers comparatively little resistance in turning. The sharp low prow is considered an absurdity in a large battleship of considerable speed. There is no question of being able to crush the side of an opponent, and the problem is to avoid injury to oneself, the sharp beak being inevitably wrenched off or bent back. Why sacrifice other important qualities for a form that viewed from any standpoint is of questionable advantage?

The stern should be of such form as to give solid water to the propellers and to bring the center of turning well aft. Triple screws seem to be economical at cruising speeds, and it will probably be found necessary to keep vessels underway most of the time in future wars, and blockading fleets at some distance from the enemy's coast. We will never again have an enemy so little disposed to do us injury as in '98, and the simple close blockade as instituted at Santiago will not be practicable. Anyway, the development of the wireless telegraph makes it less important to keep the battle squadron in close touch with the blockaded harbor, and the time required for coupling up may not be so important. Keeping steam on the central engines,

and in special cases keeping the outboard engines warm, will suffice for a blockading vessel; one set of engines being sufficient for a speed of about 14 knots. Triple screws may be again used; and we have not ceased to look for something more satisfactory than the reciprocating engine.

A vessel seldom burns all or nearly all of her coal. It is intended that the reserve bunkers be placed below the armor, outboard of the magazines and other vital parts.

The proposed battery and armor could not be carried on a less beam than 80 feet, without increasing the fullness of the water line. If greater metacentric height is desired, the water line may be made fuller without reducing the speed below 18 knots. If 19 knots speed is desired, it may possibly be attained on the form and weight proposed; but the cost would be greater, considerably, and the engines would not retain their high power long unless unusually well cared for.

A final word about the ram and the torpedo. It is usually easier to disable a battleship's battery than to sink or stop her; and in a squadron engagement the ram may well be the last alternative to defeat. A weaker vessel, sighting a battleship in a fog, or a slower vessel in ordinary weather, will find the same alternative. Nothing can stop an armored vessel with such certainty as a torpedo; I can see no sufficient reason why a battleship should not have them. There are other reasons why she should. The battleship's torpedo should have a range of 2000 yards, and she should carry at least a dozen of them, though four tubes seem sufficient for all practical purposes.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE TRAINING-SHIP.

By LIEUTENANT EDWARD L. BEACH, U. S. Navy.

To-day all the great naval services are forced to develop and train their own personnel, for no longer can the merchant service of any country be depended upon to supply, as of old, either the quarter-deck or the forecastle. This fact has long been recognized with regard to commissioned officers, and the latter day development of naval progress in ships and guns requires that before the best topman of the old school can be considered an efficient man-of-war seaman, he must be thoroughly trained in the handling of guns and gun mechanism, and other mechanical devices to be found aboard the modern warship.

The training of men for the naval service is within the power and the province of naval officers; outside of the navy there is no discussion as to the best details of training; the country leaves such matters entirely to the naval officers, and will provide the means that are said to be necessary. At present there are as many different methods of preliminary training as there are training-ships; these methods approach each other in similarity in some respects, and differ in others; this paper is submitted in the belief that all methods used are not equally good, and that naval officers should determine which is the best, and that no other should be used.

There are three different periods of training, that at the barracks, that on board training-ships, and that on board ships in regular naval service; it is the intention to discuss here the training-ship, and how it may best accomplish its peculiar purpose.

The object of all training is skill and efficiency. In providing for the defense of the country, great designers, and great build-

ers have produced powerful war vessels; these have been supplied with all manner of necessary equipment and appliances, and each, when complete, represents in its class the latest product of naval science. These are turned over to the navy, and of the navy the country demands that these vessels be as well handled, and as well fought, as they have been well built; thus it is the imperative duty of every person in the naval service to render himself efficient in the duties that devolve upon him. The history of our navy awakens the pride of every American, for it is glorious; the honor and defense of the country are to-day intrusted to the navy; thus the strongest incentives of past and of present must awaken in each member of the naval service an earnest desire that he may, by devotion to his duty, render himself efficient for such services as may be demanded of him. The ambition of every service is that each ship, whether acting singly or in squadron, may at all times be ready for any duty that may be required of it, whether in battle, or on peaceful mission. As provided by the country our ships are as near mechanical perfection as great ability and great means can build them. If historically, good men with poor ships are better than poor men with good ships, it should unanswerably follow that good men with good ships are invulnerable. The country provides the good ships, and proper training provides the good men, and thus proper training is imperatively demanded.

To be efficient it is essential that the members of a naval service should have pride, affection, and ambition in it. These qualities lacking means that duties will be but partly learned and poorly performed, and the power of the ship for offense and for defense but partially developed. The commissioned and the enlisted personnel of the ship are complements of each other; each has its important duties, each must have had thorough training, each depends upon the other; inefficiency on the part of one would lessen or destroy the efficiency of the ship. For the preliminary education of officers a great school exists, where the young officer is so trained as to be properly started upon his naval career; this school is of well-recognized excellence, and there is neither expectation nor desire of change in its general characteristics. For the early training of the enlisted man a training service has been instituted; if this is not all that could be desired it is because the navy has not authoritatively stated the exact nature, in all details, of what it should be.

Although but a few months are spent on board the training-ship, yet here the apprentice receives his first sea training, and it is of particular importance that he be started right.

The character of what the training service should be, has been and is a subject of much discussion, and at present there are different opinions regarding it. It is admitted that there are many excellent features to it, and that it has produced in many instances excellent results; but a feeling of doubt exists in the minds of many officers as to whether the training service is permanent in its present form, and some believe that as it exists to-day it could be improved upon.

If there is any doubt as to the ability of the system in use at present on board training-ships to produce the best possible results, an imperative necessity demands that this doubt be settled; this matter is of tremendous importance, for the country demands the best; the best is within reach, and nothing else should be considered.

The purposes of the training service are not only to develop the character of the young apprentice, to bring him into intimate knowledge of winds and seas, to begin his naval training, but also there should be naturally developed in each apprentice a liking for the navy and for the sea, so that a satisfactory percentage of graduates would remain in the naval service in after life; the graduated apprentice in any of the industrial trades naturally expects to follow his trade throughout his life; if his apprenticeship has been marked by thoroughness he will always be in demand; the same conditions should apply to the naval apprentice; the government has spent much upon his training, and it should be regarded as a matter of course that he should remain in the naval service as a life vocation; and his training should have been so thorough that to be an ex-apprentice should of itself be a guarantee of those qualities most desired in our seaman. If a fair percentage of ex-apprentices do not follow the naval service as a life's calling, the training service has partly failed in its purpose; this subject demands earnest study.

In the remarks that follow all of those who are being trained for the naval service are referred to as apprentices, whether they be in rate apprentices or landsmen.

THE ADMINISTRATION OF THE TRAINING SERVICE.

The present training service is composed of the training stations at Newport, San Francisco, and Port Royal, of 12 ships, and of the officers and men on duty at these stations, and attached to these ships. These stations and ships are separate units, all having a common chief in the Bureau of Navigation, but each pursuing its mission by methods more or less different from the others.

There are at a time perhaps 1500 apprentices at the different stations, and 2500 apprentices on board training-ships. The total displacement of training-ships in commission is 43,000 tons, and of all ships in commission except receiving-ships is 238,000 tons, or 18 per cent of the tonnage of all ships in commission is in the training service. Of 960 officers of all grades and corps at sea, 193, or 20 per cent, are serving on board training-ships, as is, also, about 15 per cent of the entire enlisted force of the navy; these figures show that the importance to the navy of the training-ship is well recognized by those in high authority; the Chief of the Bureau of Navigation and his assistant chief have many other duties besides those pertaining to the training service, though it would seem that the particular features of this service, so different from service in squadron, should be directed by officers detailed for this special duty. It is submitted that there should be established an Office of Naval Training, which should bear to the training service the same relation that the Commander-in-Chief and his staff bear to the squadron.

Preferably the Chief of the Office of Naval Training should be the Chief of the Bureau of Navigation. To this Office of Naval Training should be submitted all questions and matters pertaining to the training service; such an office would become a repository of knowledge, and of inestimable value.

One of the first duties of the Office of Naval Training would be to determine the type of ship which would accomplish the best results in a six months' training cruise; another duty of pressing importance would be to determine the best methods of drills and instruction for such a cruise.

We have to-day as training-ships with identical purposes—which are the first trainings at sea of apprentices—a great battleship, a number of converted freight steamers, several ships

with sails and also steam power, and several with sails only. One would naturally think that with such a peculiar mission as has the training-ship, with so much to accomplish in so short a time, the training-ship should be of a particular type. The use of such dissimilar ships as training-ships may be ascribed partly to expediency, having these ships available and there being a great need of training-ships, and also because the navy has never definitely stated just what type of ship was best suited for the purposes of the training service. It is so necessary that certain definite things should be indelibly stamped upon the character of the apprentice during his first cruise, that all training cruises should be similar with regard to methods of drill and instruction. The Indiana and the Alliance differ so widely in all respects that it must follow that the effects produced are different and not of equal excellence.

The mission of the training-ship is to bring the apprentice for the first time in working contact with the sea, to drill him in ways of usefulness, to teach him sea customs and navy discipline. The type of ship and method of drills and instruction should naturally develop his character in desirable respects, should lay the broad foundations on which future usefulness is to be built. Are all types of ships equally suited for training-ships?

The same kind of reasoning that points to one particular type of ship as best for training also emphasizes the fact that there should be one uniform system of drills and instruction in use in all training-ships. The training cruise lasts but six months, therefore it is necessary that the most efficient use should be made of the time; there are twelve training-ships, and twelve different methods of drills and instruction; these methods approach each other in some respects, and differ in others; at present, when a captain takes command of a training-ship, he makes out his routine of drills and instruction, which he sends to the Navy Department for approval; the method in use by his predecessor is not always approved by the succeeding captain, and the method used in each training-ship is not permanent in character; on board some training-ships a specialty is made of seamanship, on board others a specialty is made of gunnery; the hours of instruction vary with the ship, and also does the number of apprentices taught by each officer; on the training cruises of the Annapolis each officer had 19 apprentices to in-

struct; of the Dixie, each officer, assisted by a warrant officer, has 112 apprentices, and of the Essex each has 35 apprentices to drill and instruct. The hours for drill and instruction vary according to the ship; thus on board the Essex the periods are from 9.30 to 10.30 A. M., 10.45 to 11.30 A. M., and 1.30 to 2.15 P. M., while on board the Dixie they are from 9.30 to 11 A. M., and from 1.30 to 3.00 P. M. Summing up the training service of to-day it may be said to be composed of all sorts and types of ships, each differing more or less from its fellow; in its interior organization each ship differs from the others with respect to methods and times of drills and instruction, with the number of apprentices to be taught and trained by each officer, and with regard to the appliances on board to assist in the training. It would be difficult to conceive of a service composed of units, which, having the same mission, vary more in character and methods of training than do our training-ships. The Office of Naval Training would determine the best type and best method; the training-ships then built would be from the same model, and the same uniform method of drills and instruction would be carried on in all, and such orders and changes as would seem from time to time to be advisable would take place at the same time in all the ships.

THE PURPOSE OF THE TRAINING-SHIP.

The training of the apprentice is divided into three stages: the first occurs at the training station, and lasts from six to nine months; the second is the training cruise, which lasts for six months, and the third stage is on board ships in regular service, and lasts until the apprentice reaches the age of twenty-one years, or when he is discharged. It is not the purpose here to discuss at length either the first or the last stage of the training of apprentices. The excellence of the results of the preliminary barrack training is immediately manifested when the apprentice is received aboard the training-ship. He has received much drill at various duties; he will, without hesitation, go aloft and lay out upon a yard; he will fall into his part of the ship according to his billet with certainty, and will immediately set about to perform his prescribed duties with but little confusion; he slings his hammock and cares for his bag, is of some use in making and furling sail and in general ship duties; he has

been so well drilled in the manual of arms, in company and artillery and battalion drills, that these drills might be omitted from the routine of training ship cruises with but little loss of knowledge to the apprentice, and with great gain of time that could be put to the more pressing needs of training. He has received much instruction at marlinspike seamanship, and is always eager to learn more; in short, he has been made ready for his cruise; without this preliminary barracks training, the training-ship could not accomplish nearly as much as it does. Every day that the apprentice has spent at the station has been filled with thoughts of his coming cruise, of the strange and wonderful experiences it will bring to him, so that when he finally gets on board he is eager to learn everything possible about "going to sea"; his mind is in that plastic state so desirable in those whose characters are to be moulded for a particular purpose, and the cruise should be most striking in its effects upon him.

Captain Chadwick has recently said: "Education should, first of all, mean development in character; and acquirement of information be regarded secondary." In our future naval battles those defending our country must have qualities of courage, resourcefulness, activity, and strength, and the chief purpose of the training-ship is to lay the broad foundation of such qualities; therefore the type of the training-ship and the method of instruction should be selected with this purpose in view. In a sermon delivered some years ago to naval cadets Chaplain Clark said:

"The impression we cast upon those that pass within our shadow, they carry on forever! And our immediate influence! This touch of life upon life, how wonderful it is. Something of character goes with it. If the blacksmith puts some indefinable quality of himself into the iron he shapes, if the printed page, in order to reach its highest artistic perfection, must come from the direct touch of the printer's hand upon the press, how much more do human souls take from us impressions of character. And that which fixes the impression, that which is the impression, is character. The trade, the art, the profession being learned, that which more than anything else does the work is character. Character is in the carpenter's stroke upon the nail, it is in the sailor's pull upon the rope, it is in the officer's orders

upon the deck; it commands the ship, it paints the picture, it delivers the oration, it writes the book; it is the finest quality of gifts and of life!"

An examination of the routine of drills and instruction of some of our training-ships would convince one that their purpose, particularly, was to impart information to the apprentices, and that the development of character was an incidental, rather than a chief end. In one of our present training-ships the routine requires that in seamanship each apprentice be instructed in the following subjects:

Parts of boats, and kinds of boats; exercising boats under sails, and under oars; fleet tactics of boats; tacking, wearing, and reefing boats under sail; light-houses, buoys, running lights, fog signals; rules of the road; hand lead and line; deep sea lead and line; Thompson's patent sounding machine; the chip and patent logs; ground and current logs; the construction of the compass, boxing the compass; the helm, the thermometer, barometer, chronometer; names of all parts of ship, and ship fittings; names and uses of head booms, foremast, mainmast, and mizzen mast; kinds and parts of blocks; the standing rigging of head booms, foremast, mainmast, and mizzen mast; names, use, how fitted and how set up; fitting light standing rigging, rigging derricks; running rigging of all parts of ship; the handling of tackles, and purchases; all of the sails of the ship and their gear; bending, and furling, and reefing topsails; kinds and parts of anchors and cables, and handling them; ground tackle; the study of tides; the steam windlass; bends and hitches, knots, splices, seizings, whipping, pointing, mousing, sennett, worm parcel and serve; strapping blocks; the different kinds of rope and of small stuff; splicing wire rope.

The above is an excellent course in practical seamanship, but it may be questioned whether the apprentice who stands watch on and off, who has many ship duties, and who must devote much time to other branches of instruction, can really make thorough progress throughout such a course in six months; it is probable that he would retain but a smattering, for he could learn only a little thoroughly. To take a class of 112 young men through such a course would mean that it would be impossible for each of the 112 to receive much personal instruction, and each period of instruction would practically amount to a

lecture, where but a few could have any individual work to do. It is individual work that will accomplish most in teaching the apprentices; they are not suited either by character or desire to gain much knowledge through lectures. It would be far better if slower progress were made, but thoroughness insisted upon on the part of each apprentice in each step. As a practical illustration of the working of the above course there was time for the officer to instruct each apprentice in heaving the lead but once during the training cruise. Sincere efforts were made on the part of all officers to have the instruction as thorough as possible, and if the attainments were not as thorough as could be desired, the instructor had to content himself with the knowledge that all had been done for the apprentice that was possible in the time allowed.

At the same time that the apprentice is being drilled in seamanship, it is required that he be instructed in gunnery in each of the following subjects:

The manufacture of the 4-inch, the 6 pdr. and the 1 pdr. rapid fire guns; the description of guns, and metal used in construction; the nomenclature of guns, mounts, implements and equipments; instruction of stations at guns; of sights, and sighting allowances for wind, speed of ship and roll of ship; exercise at stations and change of stations; the study of the different breech mechanisms; firing attachments; instruction at overhauling, care and preservation of battery; the different kinds of ammunition, with the distinguishing marks, the mechanism of all fuzes and primers in use in the naval service, the preparations of the same for use; accidents incident to the use of the battery, and the methods of repairing the same; directions for mounting, dismounting, cleaning and keeping in order the guns of the main and secondary battery; the same for the Colt Automatic Gun; firing pins; recoil cylinders, and liquids used; description of magazines, the methods by which they are lighted, flooded, drained and ventilated; the estimation of distances; the practice of sighting and of getting ranges; the nomenclature of small arms; taking apart and assembling the service rifle and pistol; the school of the squad and of the company; artillery and battalion drill, dress parade; the battalion in light and heavy marching order and equipped for landing; formation for street riots; bayonet and sword exercise; cuts, parries, attacks, returns, com-

pound attacks; signals, army, navy, and Very's Codes; night, sound and fog signals; general signals; international, geographical, telegraphic, helm, speed, compass, distant and weather signals.

The excellence of this course of instruction in seamanship and gunnery is not questioned, nor could any part of it be considered as unnecessary to the knowledge of the man-of-war's man; but what it is desired to emphasize is that thoroughness is one of the qualities most desirable to be developed in the apprentice's character, and while, even with this ambitious course, a satisfactory degree of thoroughness might almost be accomplished during a six months' training cruise where the officer had twenty apprentices to instruct, it would be impossible where the officer had one hundred and twelve. What the apprentice needs is individual instruction and individual work; he learns easily by doing; but with great difficulty by hearing. The apprentice is young, and has had but little previous mental cultivation; he should be taught in ways adapted to his limitations.

Though sails have passed, yet seamanship, which may said to be the knowledge, in detail, of the efficient care and handling of all classes of ships in all circumstances, is now as necessary to the man-of-war's man as it ever was; the manly, courageous, handy and active seamen are still necessary to the efficient ship; the training cruise presents exceptional opportunities for learning details of seamanship, which will be more rarely met with by the apprentice later in ships in squadron, not but what they there exist, but because for much of the time he will be specially detailed for other duties, and also because he will not receive the individual instruction that he gets aboard the training-ship. After leaving the training-ship he will have constant work with the battery of the ship to which he is attached. It thus seems that the chief feature of the training-ship cruise should be seamanship; not that gunnery be cut out of the training cruise, but that under some circumstances the time hitherto given to some of the minor gunnery drills be devoted to seamanship. Some years ago, while in command of the training-ship Essex, Captain Dickins recommended to the Navy Department "that infantry, artillery, pistols, broadswords, and gymnastics be omitted at sea, as they may be better taught in port, and the time given to sails, spars, marlinspike seamanship, lead, log, and compass."

There is so much that is not uniform in our present methods of training apprentices that it may be possible to learn something from the methods in vogue in training apprentices for the industrial trades; one is here strongly impressed by the fact that absolute thoroughness is required in each step before the apprentice is allowed to pass to the next task; it is surely as necessary that the naval apprentice should be as well trained in the various steps in his apprenticeship, as is the industrial apprentice; yet imagine the kind of tradesmen that would be produced should the foreman go around to the different machines and required tasks with 112 not over intelligent young apprentices, and to be so rushed by the great number of different machines or tasks to be explained that but few of the 112 apprentices have opportunity to do much individual work; and this rush to different tasks to continue for six months! What useful knowledge or skill would these apprentices have acquired? And yet there are times on board training ships when the conditions approach this imaginary state of affairs in shops on shore.

In what has preceded an attempt has been made to emphasize the importance of thoroughness in naval training; the seaman can have no more desirable quality than that of thoroughness in all that he does; where the character of the apprentice is admirably developed, much information at the same time will have been acquired, for the development of character and acquirement of information are always coincident. If the instruction of apprentices is not thorough in effect, time has been wasted, and there is danger of undesirable characteristics being developed; to the apprentice who has been thoroughly trained there comes a self respect that always exists with a knowledge of usefulness; the captain to whom they are sent from the training service would receive apprentices who had been thoroughly trained in a few subjects, with great satisfaction; they would be of immediate usefulness and fitted for further advancement in knowledge of their calling. The person thorough in his calling aspires to no other; the apprentice should be so thoroughly trained in his, that he looks forward to a life's work in the navy with satisfaction and content.

THE BEST TYPE OF TRAINING-SHIP.

Admiral Luce and other distinguished officers have, at different times, with force and clearness, stated the type of ship best suited for training purposes, and their expressions are as true to-day as when uttered; for though ships may change yet the character necessary to the men who fight them must remain the same; thus again it is accentuated that "Education should, first of all, mean development in character." If this be made the chief purpose of the training cruise, if the type of the ship and method of drills and instruction be selected with this chief end in view, in addition to the desirable development in character, the apprentice will acquire much useful information.

The modern warship is so essentially different from its predecessor that doubt is sometimes expressed as to whether the training received by the old time sailor-man, good as was its purpose, is the best for the battleship seaman of to-day, whose duties are so dissimilar. The propeller has replaced the sails, the valve has replaced gear, the steering engine the wheel, and in many ways steam and electricity now do what muscle formerly did; besides skill in their calling, the men who in former days fought our sailing ships were famous for courage, daring, self-reliance, resourcefulness and activity; no one would maintain that these qualities are less needed by the crews of modern warships in battle than they were by the crews of the old frigates, nor would one say that the daring that inspired the followers of Decatur, Somers or Cushing is less to be desired now than when that daring brought glory to our country. Although a different kind of skill is required, the same qualities of manhood are demanded of our enlisted man, whether he be tending gear at the mainmast, or operating an electric hoist in a 12-inch gun turret. It is well to remember that however great be the skill acquired by the modern man-of-war's man in his various duties, in battle this skill will desert him if he has not the grand qualities of manhood to back it up; it therefore will not do to take it for granted that in the acquirement of information he will also, incidentally, have his character developed as desired. During his training cruise the character of the apprentice is in a most impressionable state, and it is desirable that the most striking effect be made upon it; this effect should not be overpowering,

but should rather awaken the interest of the apprentice; the use of a great battleship to teach the apprentice might, in some respects, be likened to an attempt to teach the beginner in the study of any science by the use of the greatest works of the deepest, most abstruse authority on the subject.

It seems to be a question to-day as to whether the Indiana or the Alliance is best suited for training-ship purposes; however true it is that the sailing-ship has gone out of date, however unnecessary sailing ship skill may be to the modern man-of-war's man, it is certain that the most desirable qualities of the seaman of to-day, be he officer or enlisted man, have unfailingly been developed by the sailing-ship. It may not be amiss to remember that the admirals and the captains, with their officers and crews, who, within recent date so completely destroyed Spain's naval power, received their early training in sailing-ships; the thoroughness of the work done is evidence of the efficiency of this training. While viewing at Cavite the wrecks of what had been Montojo's squadron, Captain Burke, famous in the British navy as an ordnance expert, said: "Had I commanded this squadron, and had these ships been manned by British crews, there might be a different history of this battle." The inference is that proper training is necessary to naval success.

Much advice on this subject has been given by those well entitled to confidence. Admiral Luce said in 1890: "The school of the topman was literally the school of danger; it prepared the man-of-war's man as no other school could, for his duties at the gun. The gun captain, above all, must be possessed of those very qualities which were the product of the severe training of topmen—physical courage, self-possession, endurance."

Captain Chadwick has said: "We want first and above all the manly, courageous, handy and active man—our training squadron should be one of sail only."

"No boy, no man, can be in the habit of furling a topgallant sail on a breezy day, or of reefing sails in a gale, without acquiring certain qualities of the highest order, such as those mentioned."

Lieutenant-Commander Harlow has said:

"It is my sincere belief that square yard and sail training is the corner-stone and cap-stone of the seaman and officer as much to-day as in the times of John Paul Jones—to withhold a single

chance from the naval apprentice handicaps his value as a helmsman or a gunner, deprives him of that development which will carry him with firm set nerves right up to and through the dreadful crisis of the ram or the torpedo."

"Away with your sails, if you please, strip your masts of their yards, but after you have done so, produce me a man to compare in fertility of resource, in keen judgment, in fearlessness, in dash, in courage, in leadership, in all that makes a manly man, with the one who has been trained at the weather earring or in smothering the mad billows of a thrashing sail! You can't do it." It was the admirable character, not skill, that urged the Gloucester amongst enemies of overwhelming power; it was character and skill that made her so formidable. The sentiment that prompted Paul Jones, when he was apparently defeated, to cry out "I have not yet begun to fight" has won more than one battle; such sentiments have characterized the history of the navy, and must be perpetuated.

The sailing-ship is better suited than the steamship to develop in the apprentice a liking for his calling. Each of the apprentice crew of the former shares the responsibility of handling her; usefulness awakens interest. In the steamship there is a feeling of reliance upon the propeller, rather than upon self. Great personal exertion for the care and safety of the steamship is required of comparatively few, and bad weather is a signal for all but these few to get under cover.

THE SIZE OF THE TRAINING-SHIP.

The particular purpose of the training-ship should determine its size. Admiral Luce has said:

"Formerly the best and most thorough school of training for the young seaman was on board the merchant sailing-ship engaged in foreign trade; this was due to the smaller crew of a merchant ship as compared to a sloop of war, and, as a consequence, the greater, and more constant demand for personal exertion."

The force of this statement must appeal to every one interested in this subject. The lesson to be drawn is that the crews of training-ships should be small; no matter how great the ship there can be but one wheel, one stem, one stern; with compar-

atively small crews, each apprentice will have more individual work to do, will receive more individual instruction, and should be more thoroughly trained. Of the 450 apprentices on board the Prairie it will not be possible for each to have much experience in a six months' cruise, at the weather wheel; it is upon the weather helmsman that responsibility rests, and it is he who really learns. The lee helmsman seldom uses his mind; he knows that the responsibility for proper steering does not rest upon him, and that his advice is not wanted. In her training cruises the Annapolis carried 76 apprentices; it is probable that each of these received more thorough instruction and training than each of the 450 apprentices of the Dixie received during her training cruises. This would not be due in the slightest degree to lack of zeal and sincere effort on the part of the Dixie's officers, but simply because of the fact that the Annapolis would naturally be the better instrument for the purpose. At the Naval Academy the instructor teaches but eight or nine cadets in the section room at a time, and at drills each cadet receives much individual direction; thus thoroughness is insured; it is only in training-ships and colleges that an instructor, who in this case is a lecturer, has anything like 112 students to lecture to. The importance of thoroughness in training should be accentuated at the very beginning of the apprentice's education; the apprentice who has not, because of any reason, been thoroughly instructed during his training cruise, may never have this quality of thoroughness developed, and the ex-apprentice who is not thorough is not encouraged to remain in the naval service. It is but an unsatisfactory per cent of the graduates of the training service who follow the navy as a calling; as a rule those who do are efficient and desirable, and are therefore encouraged to remain, and naturally they have a genuine liking for the service; every officer has known many instances of poor, inefficient ex-apprentices, of whom nothing could be made, who were therefore not desirable, and naturally were not encouraged to remain in the service; such men as these invariably lack thoroughness; they did not acquire it at the beginning of their training, nor did they ever pick it up afterwards. It is probable that had the early training of some of these men been more thorough they would have acquired habits of character that would have made them desirable, and that they would have naturally remained in the navy.

It is submitted that much better results in drills and instruction would be accomplished by an officer detailed to teach 20 apprentices than by one, assisted by a warrant officer, detailed to teach 112 apprentices; a sailing-ship carrying four divisions of apprentices, with 20 apprentices to a division, would be better suited for training than would a steamship carrying four divisions, each of 112 apprentices; such a sailing-ship should preferably be brig rigged, and of about 500 tons displacement, with no steam power whatever; it would be staunch, and, properly handled, safe in any kind of weather; this ship would require one officer to command, one officer combining the duties of executive and navigator, four watch and division officers, an assistant paymaster, and an assistant surgeon. The crew should be composed of 1 chief boatswain's mate, 3 boatswain's mates, 4 quartermasters, 8 captains of parts of ship, 4 cockswains, 4 seamen, and 4 masters at arms, with such men in gunnery ratings and below deck ratings as might be necessary, and 80 apprentices. With this crew there would be in a watch 8 men, and 40 apprentices, besides the quartermaster, boatswain's mate, and master at arms, which would be ample for handling the ship. In each part of the ship in a watch there would be two men and ten apprentices, and thus there would be many opportunities for much individual work and instruction. The apprentice would soon feel that he was of decided use and importance in the working of the ship, his interest would be kindled, his ambition stimulated, a love for the sea and for the navy would naturally be inspired; the training would be thorough, the whole tendency of the cruise would be to develop in each apprentice qualities of manliness, courage, handiness, and activity.

And the effect of such training upon the young officer detailed for duty in such ships! Imagination glows in thinking of the benefits he would receive, the qualities of quickness of perception, judgment, self-reliance, resource, that would naturally come to him in such a service, such as our older officers have always had, such as naturally come quicker and easier to those who must depend upon their own judgment without the help of the propeller. Experienced officers have said that the officer of the deck of the modern warship is always much benefited if he has had sailing-ship experience.

For the present needs of the training service twenty-five brigs

as described in constant commission would be sufficient; the battery of this brig has not been discussed; naturally it would be a number of small calibre rapid fire guns.

The expense of a training fleet of 25 brigs, such as described, would be much less that the cost of the ships at present used for training; the number of officers required would be about the same as are now detailed for training-ships, but the officers would be younger, and of less rank; with 25 brigs for training-ships, many men employed both in seaman and fire room branches would be available for the general service, and also some marines; there would be no coal expenditure, except for the galley, no wear and tear of machinery necessitating costly repairs. Summing up, it may be said that if the training fleet were composed of sailing-ships of small size better results would be obtained than are at present, at a much reduced cost to the government.

THE PRESCRIBED ROUTINE OF DRILLS AND INSTRUCTION.

So many different routines have been used in training-ships that it would not be difficult for the Office of Naval Training to create one which would produce good results; it would be natural that the commanding officer of each training-ship should be directed to comment on the prescribed routine, to point out any defects or weakness that he might notice in it, and to make recommendations with regard to it; the captains of ships to which the apprentices are sent from the training-ships would also be required to make recommendations regarding the value of this early training, with suggestions pertaining to it, and the Office of Naval Training would from time to time make such changes in the routine required to be followed in the training-ships as would seem advisable; in this way at all times the first sea training of apprentices would be exactly what the navy as a whole believed to be the best, and what it wanted.

It is the custom for the chaplains attached to the training-ships to give occasional lectures to the apprentices; these lectures as a rule are upon subjects connected with the places that are visited. In place of these lectures, and with the particular purpose of developing the character of apprentices in desirable respects, there should be furnished to each training-ship litho-

graph copies of the paintings of our famous sea fights; a course of twelve lectures, one given every two weeks, could be made interesting and effective. One lecture should deal with one battle, and during the lecture the illustrations of the fight that is being described should be displayed; the apprentices would be told of brave deeds and glorious victories; their imaginations would be most powerfully appealed to; the intent of this course of lectures, and its actual effect upon the apprentices, should be to instill in them the feeling that they are the direct successors of those heroes who followed Paul Jones, Decatur, Hull, Winslow and others to victory. Let every apprentice know something of his country's naval history, and be made to feel that all of the training he receives is to fit him to be a worthy successor of those who have brought so much credit to our naval service.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE RECRUITING OF THE NAVY PERSONNEL.

By LIEUTENANT-COMMANDER ROY C. SMITH, U. S. Navy.

The Chief of the Bureau of Navigation, the General Board, the Secretary of the Navy and President Roosevelt all call attention to a serious condition that confronts the navy. Congress as a body has had its attention called to this condition in a mild way on several occasions, but it is doubtful if the mass of the people are aware of its existence. The condition referred to is the growing shortage of officers and men to man the ships.

Since the Spanish War, the people have appreciated the navy, and have been in favor of building it up to a point commensurate with our standing and influence as a nation. It is a rare occurrence to meet and talk with an educated man who does not express opinions of this general tenor. It is curious then that so little has been done to strengthen the personnel, which is so admittedly weak.

A thing that everybody wants is apt to become a fact in course of time; but its accomplishment may be delayed through a failure to take account of some detail that is not plainly in sight, but which may be nevertheless essential. Such is the relation of personnel to the navy. When people think of the navy, the prominent idea is not the officers and men, but the ships; in other words the term navy connotes ships. We say the British navy consists of so many battleships, so many cruisers, so many gunboats, so many torpedo boats. Even well informed people would have to go and look up authorities if asked how many officers and men there are in the British navy.

With the army it is totally different. There the unit is the

man. For instance, the United States Army at war strength consists of say 100,000 men. In this contrast, I believe lies the whole difficulty. It is the reason the people do not know the personnel is short, and it is the reason nothing has been done to remedy the difficulty.

Now there is no trouble about ships. Sometimes through disagreements in Congress the building programme falls through, but in such cases it is apt to be made up at the next session. The people want a navy, they want ships, the shipbuilders want ships; and it must not be forgotten that to the influence of this last class more than to any other is due our present strength in ships. Without reflecting at all on Congress, one can easily understand that the influence of a number of large shipbuilders will make itself felt in keeping before Congress the necessity of a strong navy. But the officers and men in the navy are nobody's constituents. Here is another reason why the personnel receives no attention.

In casting about for a plan to keep the trained personnel abreast of the completed matériel, it seems evident that there must be some natural relation between the ships and the men to man them, or what is the same thing a ratio of men to tons of ship. Now as everybody thinks of the navy as composed of ships, and as the first action looking to an increase in naval strength is the authorization of ships, and as the shipbuilders are a powerful influence in keeping the necessity for ships always before the public, why not hitch personnel automatically to matériel, at a fixed ratio of so many men to every 1000 tons of ship? In other words the strength of the navy would be what Congress should authorize in ships: the personnel would have no fixed limits but would be so many officers and men to every 1000 tons of authorized shipping. The whole matter would be thus always in the hands of Congress but it would not be necessary each year to struggle to have Congress authorize the additional officers and men needed for the additional ships. The authorization of the ships would carry with it automatically an authorization of the men to man them. The time to build the ships would be available for recruiting and training the men.

Now to go a little more, though not fully, into detail. At this moment there are completed and building, according to the Navy List, July, 1901, 749,994 tons of shipping, or in round

numbers 750,000 tons. The Chief of the Bureau of Navigation states in his annual report that there will be needed 1026 additional line officers by the time these vessels are all finished, which with the number on the list makes 2068, say 2000 in round numbers or 2⅔ officers per 1000 tons of shipping. He recommends an increase of 3000 men for the current year or a total of 28,000 men and boys. As there will be in the neighborhood of 500,000 tons of shipping completed by the end of the year, the ratio may be taken as 56 men per 1000 tons. This estimate is exceedingly low, but it may be assumed to illustrate the working of the scheme.

To find the ratios of the various grades of officers, a list may be assumed in accordance with the terms of a bill already introduced for the increase of the personnel, that is 4 Vice Admirals, 14 Rear Admirals, 350 Lieutenants, 600 Lieutenants, Junior Grade, and Ensigns, and the remaining grades as at present. Leaving out the Admiral, the percentages in the other grades would be as follows:

Vice Admiral,	0.3
Rear Admiral,	1.1
Captain,	5.5
Commander,	8.7
Lieutenant-Commander,	13.0
Lieutenant,	26.3
Lieutenant, Junior Grade and Ensign,	45.1
	100.0

The staff corps could be similarly worked out. Then all that would be needed would be an act of Congress ordaining that at the beginning of each fiscal year, July 1, the finished and authorized shipping should be ascertained, and the personnel for the ensuing year should bear a relation to the total tons as expressed in the foregoing figures.

There would be some little thought required to work out all the details. For instance, the strength of personnel as above determined could hold for the whole of the fiscal year, and would contemplate promotions through the year to fill vacancies by casualty and retirement, as at present. If in any year the tonnage should fall off, the quotas could mark time at their then

strength; for it is not assumed that the navy is going to be permanently decreased at any time in the near future.

As to the source from which the new material is to be obtained, no trouble will be experienced in the higher officers. Our youngest commanders are now 51 years of age. In the British service if a man is not promoted to commander before he is 36 or 38 he feels that he has no chance of ever flying his flag. We can without doubt make promotions as needed for some time to come right down to the junior grades, but then comes the difficulty. The training of a naval officer is very technical and the four years course at the Naval Academy is entirely needful in fitting the young man for a commission. If we are to continue our building programme, about which there can be no doubt, it will be necessary to increase tremendously the output of midshipmen from the Naval Academy. There are 120 vacancies now at the foot of the ensign's list and under the present system the number is nearly stationary. Each member of Congress is now allowed one appointment every four years. He should begin at once to make one every three years, and later one every two years and even one every year if necessary. Under the present law of one every four years, and with the proposed age of admission of 15 to 18 years, a boy who is just under 15 when a vacancy in his district is filled will be over 18 when the next vacancy occurs. In other words 25 per cent of all the boys in the district will be ineligible to appointments in the natural course of events. Each Senator could well have the same prerogative as Congressmen, and the number allowed the President could be increased from the present 2½ a year to four times that number. But it is imperative that a start should be made at once. To bring up the personnel to the requisite numbers in the next five years, there would have to be about 250 graduates per year, or more than half the strength of the present cadet battalion. Assuming that the normal rate of appointment is one from each district every two years, Congress could grant to the Secretary authority temporarily to assign extra appointments to all the districts in equal quotas, within the limits that the Naval Academy could accommodate, until the vacancies at the foot of the Navy List should be filled, after which such authority would lapse.

With regard to the enlisted men, a whole book could be

written, but the following is a brief synopsis of the main requirements in that regard. In the first place the seafaring population is nothing like sufficient properly to recruit the navy. Any boy should be accepted for training as an apprentice without limit of numbers, at least if he is up to the mental, moral, and physical standard now required. But that will not keep the quotas full. Considerable effort has been made lately to enlist desirable landsmen from interior parts of the country. Here is an unfailing source. It will be necessary to go among the people with recruiting parties, a band wagon if necessary, small craft and torpedo boats up the navigable rivers, in other words to make a very persistent effort by every legitimate means to obtain desirable men for this most commendable purpose.

As to the training of these men, there are two general methods. One is to maintain a special training service for landsmen, passing the men through it as rapidly as possible, the other is to train them in the regular service. Both methods have their advocates. The pros and cons are in brief as follows: For training in special ships the limit of numbers possible to train is very soon reached. If the ships are suited to the requirements for training, they are needed for general service. The officers and men employed in training are also needed for general service. Hence the possibilities are very limited. On the other hand if every possible serviceable ship is placed in regular commission, the recruits can be distributed through the whole service and the trained officers and men will soon leaven the mass. There is no limit to the capabilities of this system, except the limit of ships, which are now in excess. The new recruits would naturally be held in barracks or receiving ships until uniformed and taught to take care of themselves. Thus all the ships would become training ships, which they are now to a great extent, and the new men would learn their duties side by side with the old, which is the method in nearly every walk in life. An ever present drawback would also be overcome, the irksomeness mature men feel when subject to the restraints of an admitted training system. The above refers only to landsmen for training and not to the very fine body of youthful apprentices who are more receptive and flexible and reflect great credit on a system that has been in effect for many years. There is one branch in their vocation landsmen will not find in battleships,

and that is the seamanship of sails. And there are many duties in a battleship which are the better done for a knowledge of this very sort. The solution lies in attaching to our squadron of drill and evolution, that is the North Atlantic Squadron, one or two purely sailing ships, with crews made up from time to time from the battleships. But there should be no training as such aboard these sailing ships. The men would simply pick up from actual practice a knowledge of the duties needful to the handling of the ships.

We naval officers as a class can each do a little towards advancing the good of the service by judicious missionary work at times when some effect is likely to be produced. A steady and uniform pressure in the right direction must be productive of results. And we may all do just a little more than consider our immediate needs from day to day. What a contrast in our naval position of to-day and that of say thirteen years ago, just before the first White Squadron appeared! And it requires no stretch of imagination to predict a progress more than equal to that of the past in the next equal interval of time. The navy is bound to increase in importance and strength from day to day. What we need then is a system of growth which shall be more or less automatic in its practical working, and as to the efficiency of the service as it grows, nothing more is needed than just to keep on with our drills and exercises in some common-sense, matter-of-fact way, without too much worry about trifles, and the difficulties will be found to smooth themselves out almost before we recognize that they are blocking us.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

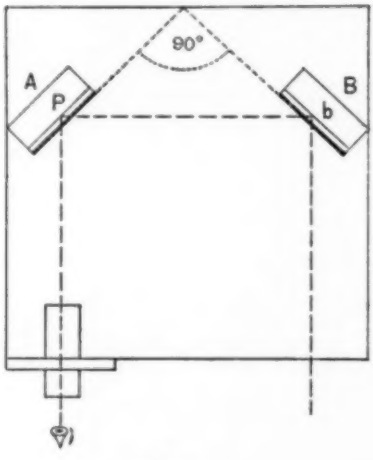
RANGE OR DIRECTION INDICATOR.

By Lieut. Armistead Rust, U. S. Navy.

The object of this instrument is to determine:—

1. When the observer is on the line joining two points when he is between them, or to show when the angle between the objects measured at the position of the observer is 180 degrees.

2. To prolong a line in any direction through the position of the observer. These two functions of the instrument render it at times of great value in navigation, hydrographic and land surveying and also in railroad engineering.

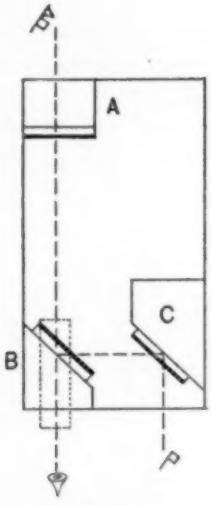


TYPE I.

In its simplest form the instrument consists of a prism or of two plane mirrors set perpendicular to a metallic or wooden base, with their silvered faces at an angle of 90 degrees, as

shown in the figure. Mirrors are recommended on account of their cheapness, though the prism has some advantages. With two sextant index glasses almost any one can make the instrument here shown. When the backs of the mirrors are covered with a heavy coating of sealing wax dissolved in alcohol and encased in thin tin or brass, they will stand moisture well. The distance between the centers of the mirrors should not be less than four (4) inches, in order for the ray of light from the rear object to clear the observer's head when the instrument is held to the right eye.

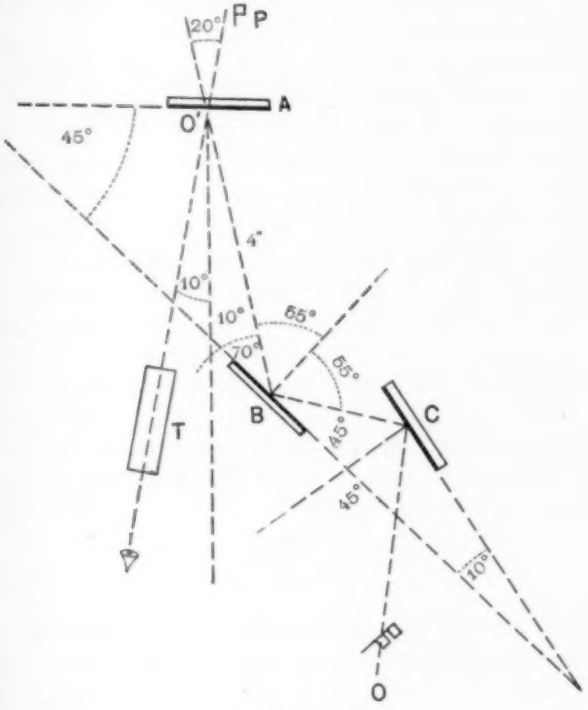
The mirrors are set perpendicular to the base, and the heavy line in each case shows the face of the mirror. The mirrors A and B may be secured to small blocks or a light casting which could hold the telescope or eye-tube and the whole be attached to a wooden base. In making a home-made instrument secure block carrying mirror A to the wooden base and set B as shown under *sextant attachment*. When using the instrument it is held horizontally, of course, like a sextant in taking horizontal angles. The telescope or sight tube should be arranged to move up and down as on a sextant.



TYPE II.

3. In Type II, the mirror A is at right angles to the line of sight and C is parallel to B. This type approaches mathematical

accuracy closer than Type I, as the mirrors A and B may be placed closer together than in Type I, about 2 inches apart, distance from A to B about 9 inches. This type has a little wider range than Type I, as by removing mirror C a beam bearing may be taken with A and B and by having B arranged so that it may be easily set at 22½ degrees we can easily take a bow bearing also.



BC = 1½ inches.
O'B = 4 inches,

TYPE III.

4. From an examination of the figure, it will be seen that if the axis of the telescope or eye-piece makes an angle of 10 degrees with the perpendicular to the mirror A through the line of sight, and the plane of B makes an angle of 45 degrees with the plane of A, and the plane of C makes an angle of 10 degrees

with B, then, when the observer is on the line joining P and O and directs his line of sight to flag P he will see the reflected image of O at O′ in the mirror A, conversely, if he directs his line of sight toward P and sees the image of O at O′, then he must be on the line joining P and O. Of course it is assumed that the rear object O is at a sufficiently great distance to render the error due to parallax inappreciable. The range of the instrument for accuracy in this respect is about the same as that of a sextant.

5. Referring to Type I. In order to attain mathematical accuracy as near as possible a vertical line should be shown on the silver side of the mirror B at b where the reflection of the intersection of the vertical plane through the axis of the telescope with the silver side of the mirror A is shown on the mirror B. A pin or notch is shown at P. If the back object be 100 yards distant and its image, falling on the vertical line b, be seen in the mirror A directly under the pin or notch P, when directed toward the front object, then the difference between the angle as shown by the instrument and 180 degrees will be less than 4′ of arc, if the back object be 500 yards distant, then the error will be less than 1′ of arc, assuming a distance of 4″ between the mirrors, which is an inappreciable quantity when compared with the beam of a ship or even that of a sounding boat.

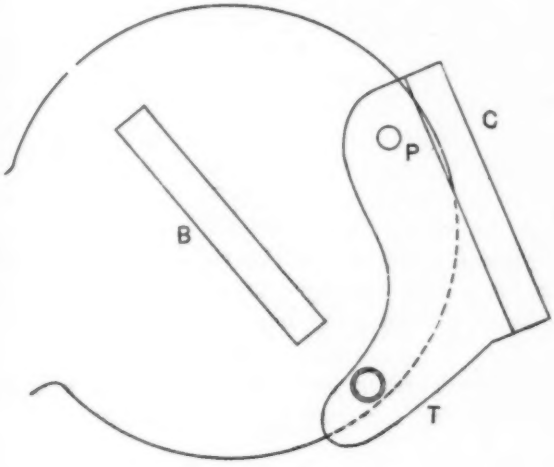
TYPE IV.

SEXTANT ATTACHMENT.

6. By adding a third mirror to an ordinary sextant we have an arrangement with which an angle of 180 degrees and over may be measured. The angle in this case is equal to the reading of the vernier plus 90 degrees. When the sextant is set at 90 degrees we have a range indicator. At times it may be desirable to be able to measure an angle of 180 degrees and over with a sextant, but for ordinary use the instrument made as described under Type I, will be found more convenient. If an extra glass be used on a sextant, it should be made to ship on the index arm outside of the regular index glass as shown in the figure in par. 4.

7. To do this practically, after the third mirror has been fitted to a proper frame of brass or aluminum, a hole should be tapped

in the index arm to correspond with the one for the thumb-screw in the mirror frame. In the sketch the circle BPT represents the end of the index arm, B the index glass, C the third mirror, T, thumb-screw, and P hole for pin, drilled in the mirror frame. Ship the mirror C and set up on T hard enough to hold the frame in place, then, having selected two objects at a sufficiently great distance apart so that the distance from the observer to the back object will be not less than about 1000 yards, take station exactly on the line between the objects, and having clamped the sextant at 90 degrees look toward the front

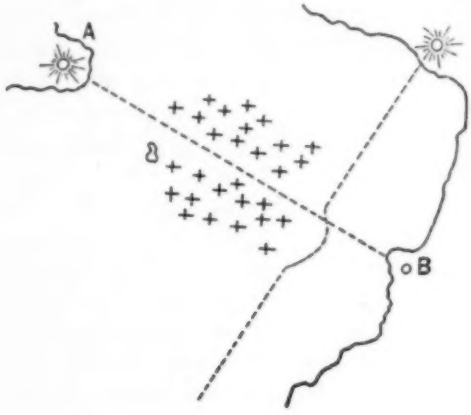


object and turn the third mirror C about the pivot T until the image of the back object is seen directly under the front object. The third glass, C is now set at the proper angle, and the position for the second hole in the index arm for the pin, P, should be marked through the hole at P. The hole in the frame should be tapped and a pin inserted to fit the hole in the index arm. This arrangement will allow the mirror C to be easily shipped and unshipped.

USE OF THE INSTRUMENT IN NAVIGATION.

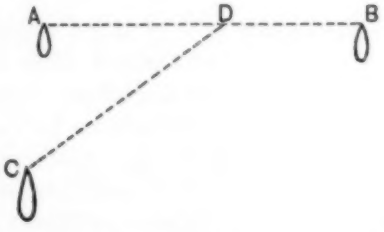
8. When circumstances permit, the observer should stand with his back to the nearer object. This not only makes the reflected image more distinct, but the range is also rendered more sen-

sitive. In using the instrument for a range—if the line of sight falls to the right of the object in front of the observer when he sees the reflected image of the rear object in the mirror A, then he is to the right of the line.



(*a*) In Types II, III, and IV, by removing the mirror C and having the glass B so arranged as to be easily set at 22½ degrees we have a convenient instrument for taking bow and beam bearings.

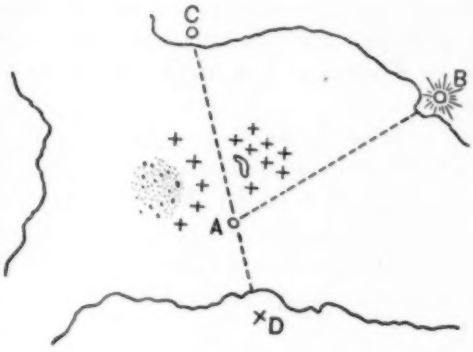
(*b*) To avoid a rock or shoal by keeping on a line between two objects when no ordinary range is available.



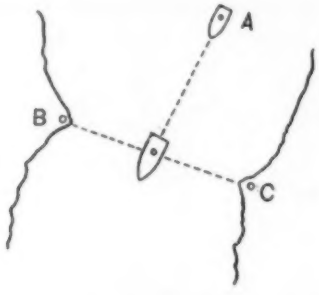
A strong tide renders the channel between the rocks dangerous, no range lights can be placed in the ordinary way, as the land at B is too high. By placing a second light or beacon at B a vessel may be safely steered between the rocks by day or night in any stage of the tide, as with ordinary range lights.

(*c*) The ship's position may be determined accurately by a

range and a single sextant angle or a range and a single compass bearing.



(*d*) To pick up a range by sextant from the chart. The angle between the desired course and some known landmark having been taken from the chart at the position of the observer with a protractor, the point to steer for is marked on the shore by setting the angle on a sextant, and then by means of the direction indicator a second point is established astern and the ship kept on the line between them.



Suppose the ship is at A, AC the course it is desired to make on the chart. The angle CAB is taken from the chart, and when placed on the sextant the point C is established on the shore by reflecting the image of the light-house B to C. Suppose this image falls on a high tree or some other prominent object. Take the direction indicator and looking at C, notice what object on the shore line or back of it is seen in the mirror under C. This establishes the point D.

(*e*) A deviation table may be very readily obtained or the deviation of the compass on any particular course checked.

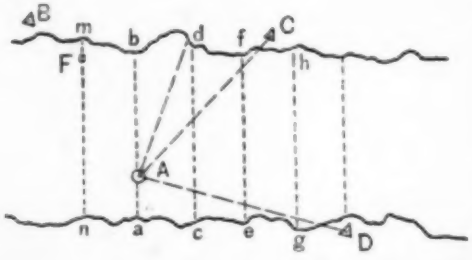
It is not always possible to see a prominent object at a sufficiently great distance for use as a distant object in obtaining deviations, and the conditions may not be favorable for the sun or reciprocal bearings.

Suppose the ship at A, about to cross the line BC. Station an assistant by the standard compass, and when the indicator shows that the compass is on the line between the two points, "mark" and note the bearing of either landmark. The magnetic bearing of the line BC is taken from the chart and the deviation for that particular course obtained.

USE IN HYDROGRAPHIC AND LAND SURVEYING.

9. The most important use perhaps, to which this instrument can be put is in running lines of soundings in rivers or harbors where the currents are strong and conditions are such that ordinary ranges cannot be established. Under these conditions straight lines of soundings greatly facilitate the plotting of the work and add to the accuracy of the chart.

(*a*) If a steam launch is the boat used and the lines are long the boat may be anchored and a range established as indicated in par. 8 (*d*), thus:—



The figure represents a boat sheet ab, cd, &c., sounding lines, B, C, D, signals. The boat is located on the line ab, at A by sextant angles. If the current be strong it may be necessary to anchor at A. The angle bAC is taken from the sheet, placed on a sextant and the image of C fixes the point b one point in the range, and a is established with the instrument by looking at b and noting the rear object in the mirror, but, under some

circumstances, it is better to have two long poles with flags, one on each side of the river or bay, which may be used as rear objects, when the bottom and the depth of the water permit. Experience will show that time will be saved by being careful to establish a good range which will save the necessity of patching up broken lines, &c.

Before getting underway from A it is well to mark approximately the beginning of the next line at d by placing the angle dAD on the sextant, then having sounded along the line ab, pick up the flag at F, used as rear mark in running the line mn, proceed to d and pick up the end of the line dc.

Where the shore line has been accurately located already on the boat sheet the angles dAD, &c., will locate the ends of the lines exactly.

(*b*) When the lines are so short or the water shoal or rocky so as to require the use of pulling boats or canoes, a piece of newspaper placed on the beach or bushes makes a good rear mark.

(*c*) The instrument will be of use to shore parties and in land surveying in setting up instruments on a line between two distant stations, and also in cutting lines through woods and brush at a minimum cost and labor, besides these there are other uses to which this instrument may be put which will suggest themselves to the practical navigator or surveyor, who does not happen to have a prismatic sextant.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NOTES ON NAVY YARD DEVELOPMENT.

By Civil Engineer H. H. Rousseau, U. S. Navy.

The estimates that have been submitted to Congress of funds necessary for the support of the navy during the fiscal year ending June 30, 1903, amount to $98,910,984.63, of which nearly twenty-nine millions, or about one-third, are for the maintenance, equipment and extension of the yards, stations, and other reservations.

While the building of vessels of the new navy commenced nearly twenty years ago, it was not until the early nineties that appropriations for the yards began to be sufficient to permit of extensive improvements being made. As a result, the development of the naval establishment ashore has been behind that of the fleet, at least ten years. Within the past five years, however, the liberal appropriations that have been made by Congress have worked a transformation, and rapid progress is now being made in furnishing the yards with modern docks, buildings, and other facilities that will soon enable them, if the appropriations continue, to care for the wants of all of the new vessels. A ratio to be followed of naval expenditures ashore to those afloat might be fixed with advantage, so that any increase in one would be accompanied simultaneously and with a corresponding change in the other.

At the regular repair and working yards, expenditures for public works, repairs, and maintenance are under the cognizance of the Bureau of Yards and Docks. Other bureaus have their own appropriations available for civil establishment, machinery and similar objects. A comparison of the appropriations for the last ten years will indicate the growth of the yards during that period.

TABLE I.

Year.	Total Naval Appropriation.	Maintenance, Y. & D.	Contingent, Y. & D.	Civil Establishment, Y. & D.	Repairs and Preservation, Y. & D.	Public Works, Y. & D.	Percentage of Y. & D. to total Appropriation.	Total for Yards & Docks.
1893	$23,543,266.65	$230,000.00	$15,000.00	$61,380.69	$275,000.00	$295,100.00	3.7	$876,480.69
1894	22,504,061.38	230,000.00	15,000.00	61,494.54	275,000.00	770,244.00	6.3	1,420,953.54
1895	25,366,826.72	250,000.00	15,000.00	61,494.54	300,000.00	597,323.05	5.1	1,304,282.59
1896	29,416,077.31	250,000.00	15,000.00	61,597.37	400,000.00	804,065.00	5.4	1,609,977.37
1897	30,562,660.95	265,000.00	15,000.00	61,486.04	400,000.00	693,355.78	4.9	1,514,566.82
1898	31,052,613.62	275,000.00	15,000,00	67,110.44	400,000.00	869,670.57	5.5	1,705,506.01
1899	113,532,306.95	350,000.00	20,000.00	72,710.44	450,000.00	4,460,812.50	4.7	5,353,522.94
1900	49,205,069.58	350,000.00	20,000.00	83,442.23	450,000.00	5,390,786.50	12.7	6,294,228.73
1901	65,130,916.67	475,000.00	50,000.00	83,439.83	500,000.00	7,305,867.32	13.3	8,714,307.15
1902	77,924,535.60	500,000.00	50,000.00	104,879.08	500,000.00	6,225,010.00	9.5	7,429,889.08
Estimates for 1903	98,910,984.63	600,000.00	50,000.00	134,204.08	500,000.00	20,281,375.00	22.6	21,565,579.08

Recent appropriations have been made for the construction of seven masonry dry docks, of a steel floating dock, and the rebuilding of one timber dock in concrete; a large number of modern fire-proof buildings have been erected; water and drainage systems have been provided; streets have been paved; wharves and quay walls built; the buildings and streets have been lighted with electricity; telephones have been installed; railroad tracks laid and connected with outside lines;—these and many other improvements have been carried out. The total value of real estate, buildings, and other structures, chattels and machinery at the different yards, as given by appraisement in 1899 was as follows:

TABLE II.

Navy Yards and Stations.	Real Estate and Chattels.	Machinery Plant.
Navy Yard, Portsmouth, N. H.	$ 2,684,627.32	$ 243,063.00
Navy Yard, Boston, Mass.	12,295,181.10	539,180.28
Naval War College, Newport, R. I.	100,422.00	
Naval Training Station, Newport, R. I.	313,005.60	7,315.00
Naval Station, Port Royal, S. C.	906,630.75	55,226.63
Naval Station, New London, Conn.	131,146.32	900.00
Naval Torpedo Station, Newport, R. I.	239,576.38	45,060.90
Navy Yard, League Island, Pa.	2,523,566.27	126,349.60
Naval Home, Philadelphia, Pa.	901,944.45	
Naval Academy, Annapolis, Md.	569,268.40	21,432.50
Naval Observatory, Washington, D. C.	869,948.77	
Navy Yard, Washington, D. C.	4,375,091.61	1,746,562.57
Marine Headquarters, Washington, D. C.	220,203.50	
Navy Yard, Norfolk, Va.	5,649,554.37	560,544.70
Navy Proving Ground, Md.	272,064.00	5,500.00
Navy Yard, Brooklyn, N. Y.	19,165,023.79	543,277.68
Naval Station, Key West, Fla.	497,837.31	37,474.48
Navy Yard, Pensacola, Fla.	1,710,821.00	51,754.00
Navy Yard, Mare Island, Cal.	4,127,611.48	435,420.00
Naval Training Station, Cal.	578,023.50	
Naval Station, Puget Sound, Wash.	798,550.55	
Naval Station, San Juan, P. R.	193,143.83	6,000.00
Naval Station, Honolulu, H. I.	595,762.32	
Total	$59,719,004.82	$4,425,061.34

The boundaries of several of the yards as originally fixed did not contemplate the performance of such a quantity of work as the yards are now called upon to do, and they are therefore becoming more and more cramped for room. New York, Norfolk

and Washington are suffering most in this respect, and there are practically no available building sites remaining in these yards, and unless property adjacent to them is acquired the growth of these yards will be checked. The estimates for 1903 include $2,535,000 for the purchase of additional land for those yards. The following table gives the size and other data in regard to the different yards and stations:

TABLE III.

Yard or Station.	Number of Acres in Yard.	Approximate Length of Wharves at which Vessels can be laid.	Depth of Water in Harbor.	Rise and Fall of Tide.	Number of Dry Docks Built or Appropriated for.
Portsmouth, N. H.	170	5,500′	30′	7.6′	2
Boston, Mass.	84	8,000′	36′	10.0′	2
Newport, R. I.	100	300′	*20′	3.6′	0
New York, N. Y.	143	10,600′	30′	4.7′	4
League Island, Pa.	923	12,500′	28′	6.2′	2
Naval Acad'y, Annapolis, Md.	76	3,800′	23′	0.9′	0
Proving Ground, I. H., Md.	1,000	96′	30′	2.0′	0
Washington, D. C.	45	3,000′	20′	2.9′	0
Norfolk, Va.	122	3,700′	28′	2.7′	3
Port Royal, S. C.	58	800′	†22′	7.0′	1
Charleston, S. C.	1,190	.....	36′	5.1′	1
Key West, Fla.	3	3,000′	27′	1.2′	0
Dry Tortugas, Fla.	23	1,700′	30′	1.2′	0
Pensacola, Fla.	80	3,200′	24′	1.17′	1
Mare Island, Cal.	900	4,000′	28′	5.0′	2
Yerba Buena, Cal.	135	600′	30′	4.2′	0
Algiers, La.	74	.....	....	....	1
Puget Sound, Wash.	190	2,000′	30′	8.1′	1
Sitka, Alaska	6¼	400′	30′	7.7′	0
Havana, Cuba	36	1,700′	‡17′	2.3′	1
San Juan, P. R.	4½	600′	24′	1.5′	0
Honolulu, H. I.	16	1,900′	30′	1.2′	0
Guam, L. I.	....	0	30′	2.3′	0
Cavite, P. I.	21	5,000′	18′	3.2′	0

*25′ a little distance out.
† Dredged to 30′ in front of station.
‡ 30′ feet to seaward.

The appropriations made for shore stations may be classed under the following principal heads:

1. Civil Establishment, which includes the pay of permanent employees.

2. Contingent, which provides for unforeseen expenses.

3. Maintenance, which includes running expenses such as fuel, light, watchman, etc.

4. Repairs and Preservation, which includes ordinary repairs to buildings and other structures.

5. Public Works, which includes all appropriations for new works including buildings, docks, etc.

Each bureau has its own civil establishment and contingent fund. Appropriations under the other three heads are made to the Bureau of Yards and Docks alone. "Maintenance" and "Repairs" are general funds to be expended for the improvement of the station and for the different departments in proportion to their needs. The demands upon maintenance naturally increase both with the growth of the naval establishment and with the amount of work being done at the yards. The amount that must be spent for repairs in order to keep the property in an efficient condition is a percentage of the total value of the existing improvements and is naturally increasing with the growth of the navy yards.

The appropriations for public works are made by Congress for specified improvements and cannot be diverted from the purpose thus fixed by law. It is interesting to compare the appropriations for the last three years and the estimates for 1903, both for the different yards and for the different departments at each of the larger yards, to ascertain the lines of development. In making this classification the eight larger working yards only are included, and each department has been charged only with such structures as it has exclusive use of. Improvements for the benefit of two or more departments, such as quay walls, grading, water systems, etc., have been classified under the heading "General Improvements."

TABLE IV.

GENERAL IMPROVEMENTS.

YARD.	Appropriation, 1900.	Appropriation, 1901.	Appropriation, 1902.	Estimates, 1903.	Total.
Portsmouth...	$15,000	$213,000	$133,500	$485,800	$847,300
Boston.....	199,000	306,300	225,500	547,500	1,278,300
New York....	294,700	353,000	248,000	2,886,000	3,781,700
League Island.	594,767	305,000	252,150	386,500	1,538,417
Washington...	7,000	10,000	47,000	185,000	359,000
Norfolk.....	345,687.50	54,000	149,000	894,500	1,443,187.50
Mare Island...	412,500	279,000	220,600	605,200	1,517,300
Puget Sound..	17,500	55,000	51,000	253,000	376,500
Total.....	$1,886,154.50	$1,685,300	$1,326,750	$6,243,500	$11,141,704.50

TABLE IV—CONT.

NEW DRY DOCKS AND REPAIRS AND IMPROVEMENTS TO OLD DOCKS.

YARD.	Appropriation, 1900.	Appropriation, 1901.	Appropriation, 1902.	Estimates, 1903.	Total.
Portsmouth...	$200,000	$225,000	$250,000	$800,000	$1,475,000
Boston.....	200,000	274,800	250,000	501,200	1,226,000
New York....	.....	580,000	300,000	17,000	897,000
League Island.	200,000	253,000	250,000	255,000	958,000
Washington...	.....	.....	.....	.....	.....
Norfolk.....	.....	230,000	315,000	35,000	580,000
Mare Island...	200,000	225,000	250,000	267,500	942,500
Puget Sound..	.....	7,165	.....	.....	7,165
Total.....	$800,000	$1,794,965	$1,615,000	$1,875,700	$6,085,665
CONSTRUCTION AND REPAIR DEPARTMENT.					
Portsmouth...	$105,000	$37,000	$110,000	$205,000	$457,000
Boston.....	.....	200,000	225,000	275,000	700,000
New York....	8,000	104,000	185,000	143,000	440,000
League Island.	75,000	199,200	97,280	40,000	411,480
Washington ..	100,000	44,500	.....	67,000	211,500
Norfolk.....	100,000	17,500	10,000	210,000	337,500
Mare Island...	197,000	62,700	59,150	52,000	370,850
Puget Sound..	8,000	12,000	74,000	346,000	440,000
Total.....	$593,000	$676,900	$760,430	$1,338,000	$3,368,330
EQUIPMENT DEPARTMENT.					
Portsmouth...	$100,000	$100,000	.....	$69,775	$269,775
Boston.....	130,000	190,000	35,000	220,000	575,000
New York....	178,000	4,700	130,000	60,000	372,700
League Island.	86,000	116,800	33,000	100,000	335,800
Washington...	.....	40,000	.....	60,000	100,000
Norfolk.....	.....	.....	87,500	98,000	185,500
Mare Island...	84,500	72,000	.....	.....	156,500
Puget Sound..	.....	125,000	75,000	295,000	495,000
Total.....	$578,500	$648,500	$360,500	$902,775	$2,490,275
MEDICINE AND SURGERY DEPARTMENT.					
Portsmouth...	$6,000	.....	$500	.....	$6,500
Boston.....	.....	.....	.....	$12,000	12,000
New York....	.....	$12,000	.....	.....	12,000
League Island.	.....	.....	.....	.....	.....
Washington...	.....	.....	.....	.....	.....
Norfolk.....	.....	10,000	.....	500	10,500
Mare Island...	.....	7,500	.....	30,000	37,500
Puget Sound..	.....	.....	7,000	.....	7,000
Total.....	$6,000	$29,500	$7,500	$42,500	$85,500

TABLE IV—CONT.

YARDS AND DOCKS DEPARTMENT.

YARD.	Appropriation, 1900.	Appropriation, 1901.	Appropriation, 1902.	Estimates, 1903.	Total.
Portsmouth...	$80,000	$6,000	$12,000	$33,000	$131,000
Boston.....	50,000	95,000	.....	27,000	172,000
New York....	32,000	85,000	.....	240,000	357,000
League Island.	.....	20,000	.....	50,000	70,000
Washington...	10,000	.....	20,000	155,000	185,000
Norfolk.....	75,000	77,500	2,000	63,000	217,500
Mare Island...	4,000	52,000	7,000	23,000	86,000
Puget Sound..	23,000	7,000	44,500	45,000	119,500
Total.....	$274,000	$342,500	$85,500	$636,000	$1,338,000

STEAM ENGINEERING DEPARTMENT.

Portsmouth...	.....	$50,000	$15,000	$497,000	$562,000
Boston.....	.....	135,000	65,500	87,500	288,000
New York....	$474,362	.....	.....	6,000	480,362
League Island.	.....	255,500	191,000	84,800	531,300
Washington ..	.....	.....	.....	.....	.....
Norfolk.....	50,000	80,000	30,000	25,000	185,000
Mare Island...	150,000	.....	.....	5,000	155,000
Puget Sound..	.....	.....	12,000	.....	12,000
Total.....	$674,362	$520,500	$313,500	$705,300	$2,213,662

SUPPLIES AND ACCOUNTS DEPARTMENT.

Portsmouth...	.....	.....	$83,000	$107,000	$190,000
Boston.....	.....	.....	.....	150,000	150,000
New York....	.....	$118,000	6,000	123,000	247,000
League Island.	$45,000	.....	79,800	50,000	174,800
Washington ..	.....	4,000	.....	15,000	19,000
Norfolk.....	.....	3,200	760	150,000	153,960
Mare Island...	66,250	5,000	44,910	.....	116,160
Puget Sound..	.....	.....	.....	150,000	150,000
Total.....	$111,250	$130,200	$214,470	$745,000	$1,200,920

ORDNANCE DEPARTMENT.

Portsmouth...	.....	.....	$10,850	$50,000	$60,850
Boston.....	.....	.....	.....	50,000	50,000
New York....	.....	$12,200	140,000	.....	152,200
League Island.	.....	15,000	42,000	.....	57,000
Washington ..	$88,000	235,602.32	250,610	140,000	714,212.32
Norfolk.....	75,000	.....	.....	35,000	110,000
Mare Island...	22,000	.....	.....	131,000	153,000
Puget Sound..	...	80,000	9,500	84,500	174,000
Total.....	$185,000	342,802.32	$452,960	$490,500	$1,471,262.32

In the same way there may be tabulated the number of buildings used at the different yards by each department, the approximate floor area occupied and the value of the buildings, as giving an indication of the relative importance of the yards and the requirements of the different departments. The figures given include all buildings for which appropriations have been made, whether the buildings have been erected or not, but do not include the buildings estimated for 1903.

TABLE V.

CONSTRUCTION AND REPAIR DEPARTMENT.

YARD.	No. Buildings.	Floor Area.	Value.
Portsmouth	21	285,711	$ 411,000
Boston	26	449,000	1,679,100
New York	17	538,645	1,055,475
League Island	13	355,935	438,023
Washington	4	56,444	237,575
Norfolk	19	482,994	504,200
Mare Island	29	436,988	967,795
Puget Sound	7	100,508	186,916
Total	136	2,706,225	$5,480,084
YARDS AND DOCKS DEPARTMENT.			
Portsmouth	22	81,038	$110,700
Boston	19	155,075	423,416
New York	26	196,062	436,790
League Island	16	95,260	152,150
Washington	13	24,926	88,420
Norfolk	15	135,050	191,750
Mare Island	41	174,455	315,319
Puget Sound	21	36,874	37,556
Total	173	898,740	$1,756,131
EQUIPMENT DEPARTMENT.			
Portsmouth	5	142,237	$ 244,955
Boston	17	385,160	1,190,716
New York	5	134,474	229,500
League Island	4	74,040	99,100
Washington	2	11,690	52,000
Norfolk	3	68,500	39,000
Mare Island	13	117,114	291,332
Puget Sound	4	65,250	130,654
Total	53	998,465	$2,277,257

TABLE V—CONT.

STEAM ENGINEERING DEPARTMENT.

YARD.	No. Buildings.	Floor Area.	Value.
Portsmouth	9	121,194	$203,700
Boston	2	67,293	207,000
New York	7	191,310	666,200
League Island	8	165,726	517,800
Washington	1	4,830	12,000
Norfolk	7	126,441	150,200
Mare Island	15	195,390	648,800
Puget Sound	1	24,356	56,000
Total	50	896,540	$2,461,700

SUPPLIES AND ACCOUNTS DEPARTMENT.

Portsmouth	6	157,550	$ 271,250
Boston	6	148,243	420,000
New York	14	479,541	770,894
League Island	6	149,926	248,900
Washington	4	13,482	26,150
Norfolk	8	127,640	125,650
Mare Island	7	303,070	309,500
Puget Sound	2	19,668	20,100
Total	53	1,399,120	$2,192,444

ORDNANCE DEPARTMENT.

Portsmouth	11	59,767	$ 136,800
Boston	5	25,601	64,166
New York	13	183,631	310,046
League Island	2	25,670	41,000
Washington	48	482,869	2,025,100
Norfolk	2	74,780	100,000
Mare Island	5	65,640	82,660
Puget Sound	6	23,174	80,307
Total	90	951,132	$2,840,079

MEDICINE AND SURGERY DEPARTMENT.

Portsmouth	1	3,500	$ 6,200
Boston	..	....	....
New York	17	167,439	332,340
League Island	1	1,500	600
Washington	3	6,421	4,900
Norfolk	3	5,756	13,500
Mare Island	1	4,386	5,000
Puget Sound	2	6,000	7,550
Total	28	195,002	$370,090

TABLE V—CONT.

OFFICERS' QUARTERS.

YARD.	No. Buildings.	Floor Area.	Value.
Portsmouth	13	71,123	$ 91,667
Boston	13	50,565	105,000
New York	11	59,855	86,412
League Island	10	42,177	61,276
Washington	12	52,994	78,000
Norfolk	14	41,092	22,000
Mare Island	13	128,847	133,000
Puget Sound	5	29,600	25,000
Total	91	476,253	$602,355

The figures given under the column headed "floor area" are based upon the outside dimensions of the buildings and do not exclude partitions. Where a department occupies only a portion of a building it has been credited with one building under the column headed "No.", but only the actual area occupied has been charged against it in the adjoining column.

Among the most extensive improvements that are being carried on at the different yards are the construction of dry docks and coaling plants. In 1898 an appropriation was made for four dry docks to be located at the Portsmouth, Boston, League Island and Mare Island navy yards. The appropriation was made for timber dry docks, but, under authority given the Secretary of the Navy, two were afterwards changed to concrete and stone, and in 1900 Congress authorized the same change being made in the other two, so that all four will be masonry. These docks are larger in every way than the docks previously built. At the Portsmouth yard the excavation for the dock was made from solid rock, which is being lined with cut granite laid in concrete. This dock is about 42 per cent completed. At the Boston yard the new dock rests upon a hard-pan bottom without piling. The dock is of heavy concrete construction with a granite lining. It is now 45 per cent completed. One contractor is building the League Island and Mare Island docks, and work on these docks has been somewhat delayed pending negotiations as to increased compensation on account of changing the material of the docks from timber to concrete and stone. The League

Island dock rests on natural bottom without piling and consists of monolithic concrete, with granite lining over a portion of the interior. This dock is 20 per cent completed. The Mare Island dock will be supported on piles and be made of concrete with some granite on the interior. The dock is also about 20 per cent completed. With the construction of these docks the Government has definitely committed itself to masonry in preference to the timber docks, which have been found to become unserviceable after a comparatively few years, unless a considerable outlay is made for repairs.

The cross-section of the new docks approximates that of the timber docks, which will afford good working light and air at the bottom, and overcomes one of the objections that has been made to docks of this type. The altar design includes about a dozen steps at the bottom having a rise of one foot and a tread averaging about a foot. Above these steps, the altars are 2 or 3 feet broad, and the risers about 6 feet. Appended are the principal dimensions of the new docks:

	Portsmouth.	Boston.	League Island.	Mare Island.
Length on coping, head to outer sill	750′	750′	750′	755′
Length on floor, head to outer sill	725′	729′	723′	728′
Width of entrance at coping	101′ 9″	101′ 8⅝″	102′ 7¼″	101′ 11¼″
Width at coping in body of dock	130′	114′	134′	126′
Width of floor, body of dock	80′	72′	80′	72′
Depth over sill at mean high water	30′	30′ 7½″	30′	30′
Mean rise and fall of tide	7′ 7″	10′	6′ 2″	5′

At the same time the above docks were authorized, Congress appropriated $850,000 for a steel floating dock at Algiers, now named the New Orleans Naval Station. This dock was built at Baltimore and towed to the station in November, 1901. It was tested in January, 1902, by successfully docking the battleship Illinois. The principal dimensions of this dock are as follows:

Length overall ..... 525 feet.
Clear width inside at top of trunks ..... 100 feet.
Draft accommodated ..... 28 feet.
Lifting capacity ..... 15,000 tons.

Another series of stone and concrete docks has been authorized by Congress consisting of one dock at New York to cost

$1,000,000, one at Norfolk to cost $1,200,000, and one at the new Charleston Navy Yard, to cost $1,250,000. The plans for these docks have been nearly completed and it is expected contracts will be made for their construction early in the spring. These docks will be even larger as regards depth and width than any that have been constructed in this country. With the exception of the New York dock, which will be entirely of concrete, they will be of concrete with a granite lining. A number of improvements have been embodied in them in order to increase their efficiency. When they are completed the New York yard will have four dry docks and there will be no room for future dock construction. The Norfolk yard will have three docks and all available building room will likewise have been exhausted. The dimensions of the new docks are as follows:

	New York.	Norfolk.	Charleston.
Length on coping from head to outer sill	571′	600′	600′
Length on floor, head to outer sill	550′	573′	573′
Width of entrance at coping	90′	112′ 6″	112′ 6″
Width at coping in body of dock	132′	144′	144′
Width on floor in body of dock	90′	90′	90′
Depth over blocks at mean high tide	31′	32′	32′
Mean rise and fall of tide	4′ 8″	2′ 9″	5′ 1″

The pumps for the new docks are of the centrifugal type, electrically operated from a central power plant. The total cost of the eight (including Algiers) docks will be about $8,500,000.

The estimates for 1903 include $500,000 for the construction of a steel floating dry dock for the Portsmouth Navy Yard to replace the present wooden floating dry dock which has been used for the last fifty years, $160,000 for lengthening the old stone dock at the Boston yard, and also $1,000,000 for a masonry dock at the San Juan Naval Station. In July, 1901, the Government purchased from the Spanish Government the steel floating dry dock in the harbor of Havana for $195,000. This dock has a capacity of 10,000 tons and is being overhauled and repaired preparatory to towing it to the Philippine Islands. In 1899 the Government acquired by purchase a wooden floating dock having a capacity of 2200 gross tons, which is now stationed at the Pensacola Navy Yard.

In the way of coaling plants, there have been recently constructed sheds and coaling machinery at the New London, Key

West and Dry Tortugas stations and at the Mare Island Navy Yard, having a total capacity of over 50,000 tons. These plants are of the type in which coal is stored in a shed upon the water front and is conveyed to and fro by means of a power shovel running on a large overhead tramway or bridge.

Within the past year contracts have been entered into for coaling plants at the Portsmouth, Boston, New York, Washington and Puget Sound navy yards, which will have when completed a capacity of more than sixty thousand tons. League Island and Norfolk will also soon be provided with coaling plants. Arrangements have been made for improving the coaling facilities at the San Juan Naval Station. The Tutuila Naval Station has a coal shed of 5000 tons capacity and steps are being taken to double this capacity.

In all of the plants that are now being built the coal rests upon a floor raised from the ground so that coal can be drawn through valves in the floor from any portion of the bottom of the pile. To avoid the danger of ignition, the height to which coal is stored in the sheds is limited to 20 feet. The new plants have been designed to meet the necessities of modern war vessels, and so as to allow coaling to proceed at a very high speed,—as fast as it can be stored in the vessels' bunkers. At most of the yards coal will be chuted directly aboard the vessel by gravity. The plants will be provided with a large number of new and improved devices designed to reduce the labor and discomfort of coaling ship to a minimum, as well as the cost of handling the coal.

The proper care and preservation of torpedo vessels has become an important matter for which adequate facilities must be provided. In April, 1901, a board was appointed by the Department to consider the question and to recommend the yards at which facilities should be provided. It was recommended that suitable rendezvous for the accommodation of torpedo-boats "in commission in active service" and "in commission in reserve" be established at the Portsmouth Grove Coaling Depot, the Norfolk Navy Yard, the Charleston Navy Yard, the Pensacola Navy Yard and the Mare Island Navy Yard. The board recommended that wet basins only be constructed at first, but as soon as funds become available that a locking-up basin with dry stalls sufficient to accommodate a group of eight boats for each rendez-

vous, be built. The report was approved and the construction of slips has commenced at the Norfolk Navy Yard, to be followed by plants at the other yards named as soon as funds become available. The estimates for 1903, include $2,125,000, for plants for the care of torpedo vessels. To provide for additional torpedo vessels, the following places were recommended in the sequence named, whenever additional rendezvous should become necessary:

ATLANTIC AND GULF COASTS.

In the vicinity of Rockland, Me.
In the vicinity of Fernandina, Fla.
In the western part of the Gulf Coast.
In the lower Delaware River.
In the vicinity of Tampa, Fla.
In the vicinity of Wilmington, Del.
In the lower Mississippi River.

ON THE PACIFIC COAST.

Navy Yard, Puget Sound.
In the vicinity of San Diego, Cal.

To provide additional facilities for hauling out torpedo vessels at working navy yards, locking-up basins and dry slips were also recommended to be constructed at the Boston and New York navy yards.

Some of the more important improvements projected at the different yards may be briefly enumerated as follows:

At the Portsmouth Navy Yard bids have been received for the removal of Henderson's Point, a rocky ledge jutting out from Seavey's Island, which is a menace to navigation between the yard and the lower harbor. The lowest bid for the removal of the point for a distance of 350 feet to a depth of 35 feet below mean low water is $749,000, and the work will be undertaken as soon as Congress acts favorably. The department of steam engineering has been assigned a plat of ground on Seavey's Island near the entrance to the dry dock, for a group of buildings to be erected for its use.

At the Boston yard the recent relocation of the Harbor Commissioners' line in front of the yard has permitted the building

out of a number of wooden wharves, which largely increases the berthing room for vessels at the yard. A number of large new buildings are under contract for the departments of construction and repair, equipment and yards and docks.

At the New York yard the development of Cob Dock Island, to increase the berthing room for vessels is being carried on as fast as the appropriations for new piers will permit. In December, 1901, the War Department approved the change in the pier-head and bulkhead line in front of Cob Dock, which had been requested by the Secretary of the Navy. The new bulkhead line is an arc of a circle of 3500 feet radius and is situated from 300 to 400 feet farther out in the stream than the pier-head line which has governed during the past eleven years. There has thus been added to the area of the yard available for either berthing vessels or for building piers, about 12 acres, without cost to the Navy Department. At present there is nothing more needed at the New York yard than more wharf room, and with this new jurisdiction line at least seven piers having an aggregate berthing room of about nine thousand feet can be built out into the East River from the Cob Dock. The main part of the New York yard has been entirely built up and unless the yard limits are extended, any future growth must be on Cob Dock Island. An appropriation has been available for two years to construct a bridge of the bascule or uplifting type over the Wallabout Channel to render the Cob Dock more accessible, but on account of the increased difficulties to navigation that would be caused thereby to large vessels through the channel, which is not straight at this point, its construction has been deferred. One of the projects under advisement for execution after the new piers have been built on the Cob Dock, is to connect Whitney Basin directly with the East River by a channel of sufficient width for easy navigation, the opening to be spanned by a bascule bridge. This would then become the main entrance for large vessels to Whitney Basin and to the dry docks, and objections to the construction of a bridge across Wallabout Channel would be removed. One new pier is being built 500 feet long, on which the new coal shed and coal handling machinery will be erected. The proposed new piers, if built out to the new bulkhead line, will vary in length from about 500 feet at the northeast end of the island to 750 feet at the southwest end. With these new piers the New

York yard will be able to provide berths for nearly double the number of vessels it does at present, and the improvement is one that is very much needed. This new construction on Cob Dock will also tend to check any further attempts to legislate away from the jurisdiction of the Navy Department a portion of the east end of the island, bills for which have been introduced at each of the recent sessions of Congress.

At League Island Navy Yard the extension of the reserve basin, including the building of a retaining wall around the dredged basin, constitute an important portion of the work being done there. The reserve basin as planned, will have a depth of thirty feet at mean low water and the south side will be provided with a number of piers, inclined towards the entrance to permit easy ingress. The recent relocation of the Harbor Commissioners' line along the Delaware River front will permit of the extension of the piers already built and of those proposed.

In regard to some of the stations which have been recently established, the New Orleans Naval Station, which is situated on the Mississippi River opposite the city of New Orleans, has a water frontage of about 1200 feet. The property has a depth of about 3000 feet. Buildings are being constructed for the departments of construction and repair and steam engineering. The purchase of additional land east of the present property has been authorized by Congress, and condemnation proceedings instituted for property that will increase the water front to about 4200 feet. As soon as the Government can secure possession of this land, improvements will be undertaken upon it.

Congress authorized by Act of March 3, 1901, the transfer of the Port Royal Naval Station to a site upon the Cooper River about six miles above the city of Charleston, to be known as the Navy Yard, Charleston, S. C. The Government secured title, by negotiations conducted with the owners of the various tracts of land, to about 429 acres for the main part of the yard and 760 acres of marsh land at a cost of $84,207. Negotiations are now being made for the purchase of about a thousand acres of marsh land on the east bank of the Cooper River opposite the Charleston Navy Yard. A general plan for the development of this station was prepared by a board, which provides for the construction of two dry docks and a torpedo-boat rendezvous, together with such storehouses and other structures as are neces-

sary for a yard of the size on which this yard has been laid out. The plans of the board have received the general approval of the Department and it is proposed to commence the construction of one dry dock and a torpedo-boat rendezvous this spring, to be followed by such other structures as there are funds available, the balance of the Port Royal appropriations having been transferred to Charleston with the station. It is the intention to make Port Royal a training station hereafter. The dry dock has been declared out of commission and not worthy of repair. During the winter a group of torpedo-boats has been moored in the dry dock basin.

Estimates amounting to $2,613,000 for public works for the Naval Station, San Juan, P. R., have been submitted to Congress, which include a masonry dry dock costing $1,000,000, an extension of coaling facilities costing $200,000 and purchase of land amounting to $500,000. These improvements were recommended by a board authorized by Act of March 3, 1901, to make an examination of available locations in Porto Rico and recommend a site for establishing a naval station. The site recommended is in the harbor of San Juan and includes a portion of the present navy yard. The public lands upon the peninsula forming the new naval station site have been allotted to the Navy Department as a part of the station, by executive proclamation. The land owned by individuals must be secured through negotiation or condemnation proceedings.

Estimates for the Naval Station Tutuila, Samoa, amount to $108,000, and include $30,000 for grading and filling and $35,000 for the purchase of land upon which to build an extension to the coaling plant. The station at present consists practically of only a coal shed and pier. A residence for the commandant is under construction. Included in the estimates for the coming year are those for officers' quarters, a court house, a telephone system and water works and accessories. It is not the intention at present to begin the construction of any repair shops.

At Guam no public works are contemplated aside from the building of roads. The estimates amount to $12,300.

In the Philippine Islands the presence of a large fleet will require extensive appropriations for several years. Congress authorized in 1901 the examination of the Philippine Islands with a view to establishing a naval station. The board recommended

Olongapo in Subig Bay, Isle of Luzon, as a suitable site, and a board was appointed to draw up a plan for laying out a naval station, together with an estimate of cost of same. The board's estimate of the cost of this station is between six and seven millions, and estimates have been submitted to Congress for $1,443,000 to commence carrying out the board's recommendations.

While it is contemplated to make Olongapo the principal repair station in the Philippine waters, considerable work will always be done at the naval station which is at Cavite, and it is considered necessary to expend during the coming year $381,000 in order to make needed improvements there.

It has been impossible, in an article of this length, to trace in detail the growth of the different yards or touch upon many interesting phases of their development. The changes in ship construction, due to the substitution of metal for wood, have been accompanied with corresponding changes in navy yard conditions that it has been necessary to meet. Whatever the future brings forth, the growth of the yards should be sufficient to enable them to keep all of the vessels of the navy in a state of preparedness for active service.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

BETHLEHEM STEEL COMPANY,

SOUTH BETHLEHEM, PA., U. S. A.

TEST OF CONICAL AND CYLINDRICAL BREECH BLOCKS.

Bethlehem Steel Company, January, 1900.

HYDRAULIC TESTS OF CONICAL AND CYLINDRICAL BREECH PLUGS.

First test.	Length.	Diameter rear	Diameter front.	Threaded area.	Weight of threaded portion in pounds.
Conical Plug....	1.5″	3″	2″	11.78	2.12
Cylindrical Plug.	2.0″	3″	3″	9.4	4.

A load of 350,000 pounds corresponding to 112,500 pounds per square inch of powder pressure was applied without injury to either plug.

Second test.	Length.	Diameter rear	Diameter front.	Threaded area.	Weight of threaded portion in pounds.
Conical Plug....	1.5″	3″	2″	11.78	2.12
Cylindrical Plug.	1.5″	3″	3″	7.05	3.

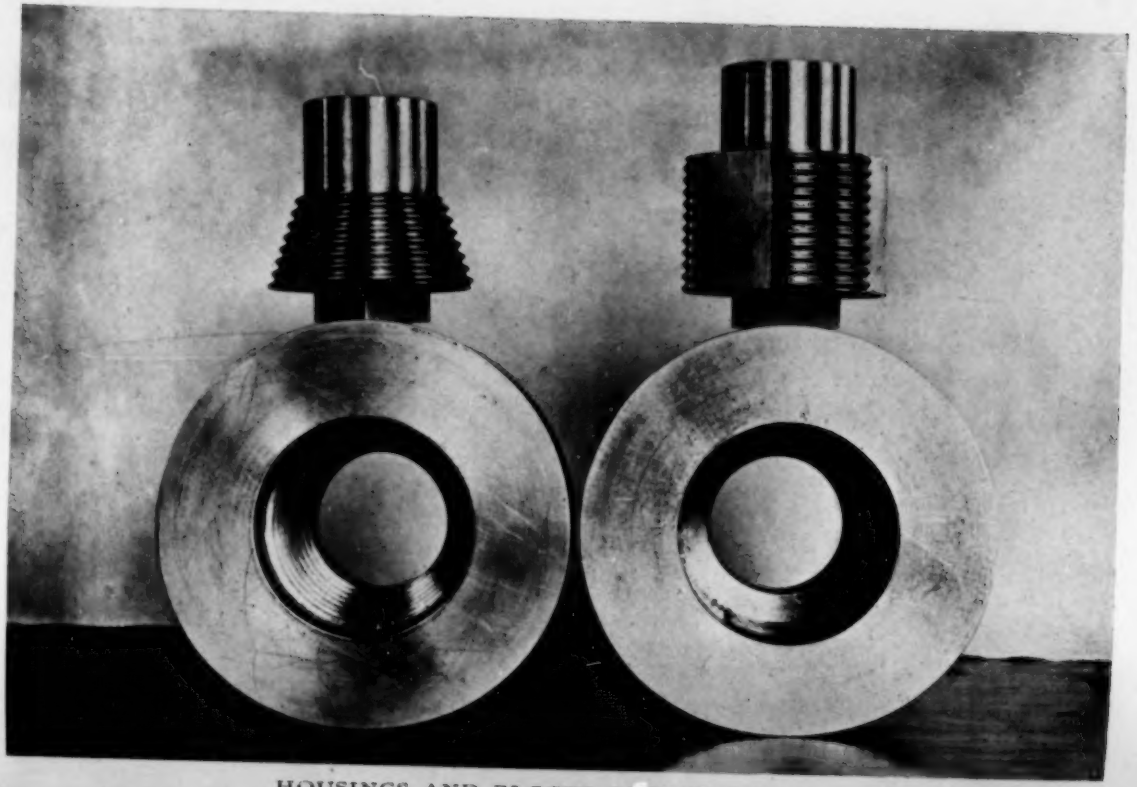
The conical plug was again subjected to the load of 35,000 pounds without injury, while the cylindrical thread sheared under a load of 340,000 pounds corresponding to a pressure of 108,000 pounds per square inch in powder chamber.

ANALYSIS OF REPORT OF FEBRUARY, 1900.

March 6, 1900.

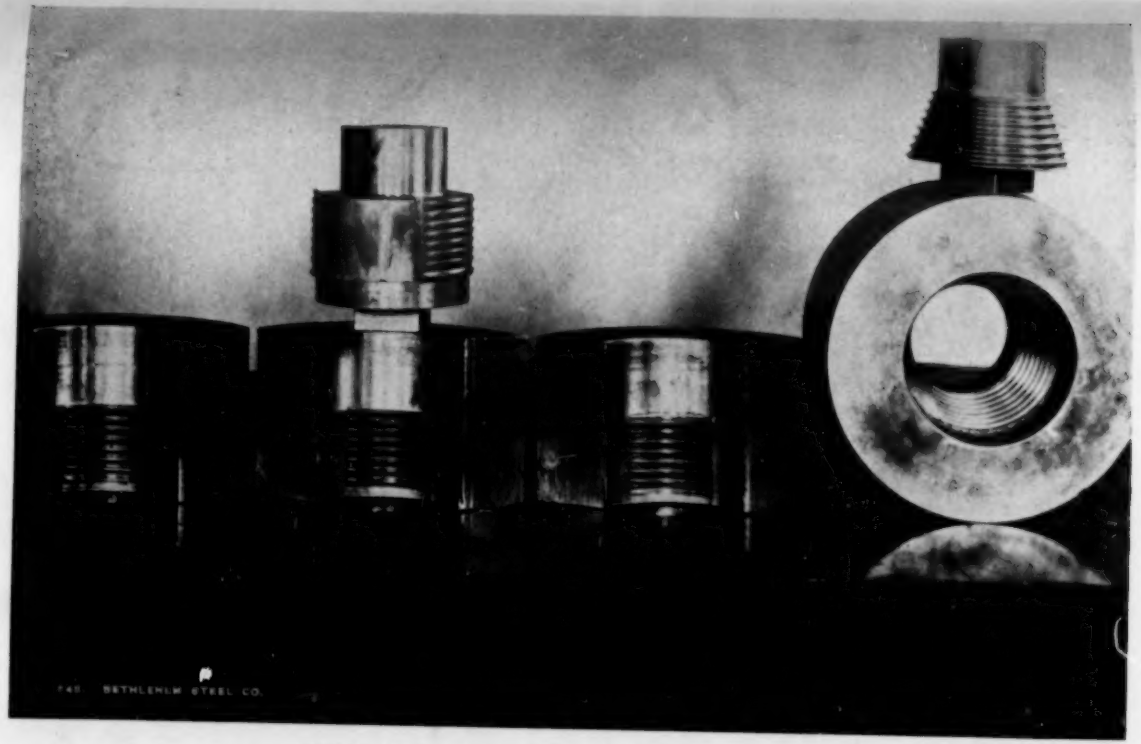
MR. R. W. DAVENPORT, General Superintendent.

Dear Sir:—I send you two copies of the report of the test of conical and cylindrical breech blocks, undertaken to determine the value of the new Bethlehem conical continuously threaded breech block, compared with the breech blocks of the existing types of interrupted cylindrical threads; the claims for the new breech block being, that it is stronger and will open and close with greater ease than a cylindrical block of the same weight.



HOUSINGS AND BLOCKS BEFORE TESTING.

HOUSINGS AND BLOCKS BEFORE TESTING.



HOUSINGS AND BLOCKS AFTER TESTING.
(Housing for cylindrical block cut through to show shearing of thread.)

The plugs tested were the standard plug for the 5-inch U. S. Army gun, a plug of more than ordinary strength and the conical plug of the Bethlehem 5-inch gun. These plugs were first tested as far as the strength of the gun would allow, then one-half of the threaded area was removed from each plug, as shown on photograph and the test continued to destruction. In the table of this latter test there is first a column of actual pressure, and then a column of estimated pressures, which would have strained the full original thread to the same extent. This latter column I have added to show the full strength of the respective plugs in comparison to that of the gun as expressed in pressure per square inch of powder chamber. The table will show some upsetting of the threads of both plugs early in the test. This I consider due to unavoidable imperfection in workmanship, such as roughness of surfaces, and an inaccurate fit. The elastic strength of the gun under hydraulic pressure is about 40,000, while that of the cylindrical plug seems to be about 60,000, and that of the conical plug is between 70,000 and 80,000. The superiority of the conical plug is due to its greater threaded area. The greater ultimate strength of the cylindrical plug (125,000 as against 110,000 for the conical plug) is not very important, as no gun (certainly not a light gun like the 5-inch army gun) could be subjected to a pressure of over 100,000 pounds per square inch without bursting, and the cylindrical plug was made useless under a pressure, which the conical plug stood without having its quality of ease of opening and closing materially impaired.

It should further be remembered that the threaded portion engaged on the conical plug weighs about 53 pounds while the corresponding part of the cylindrical plug weighs 74 pounds, and that consequently weight for weight, the conical plug has 12 per cent greater ultimate strength, and fully 70 per cent greater elastic strength than the cylindrical plug.

Yours truly,

J. F. MEIGS.

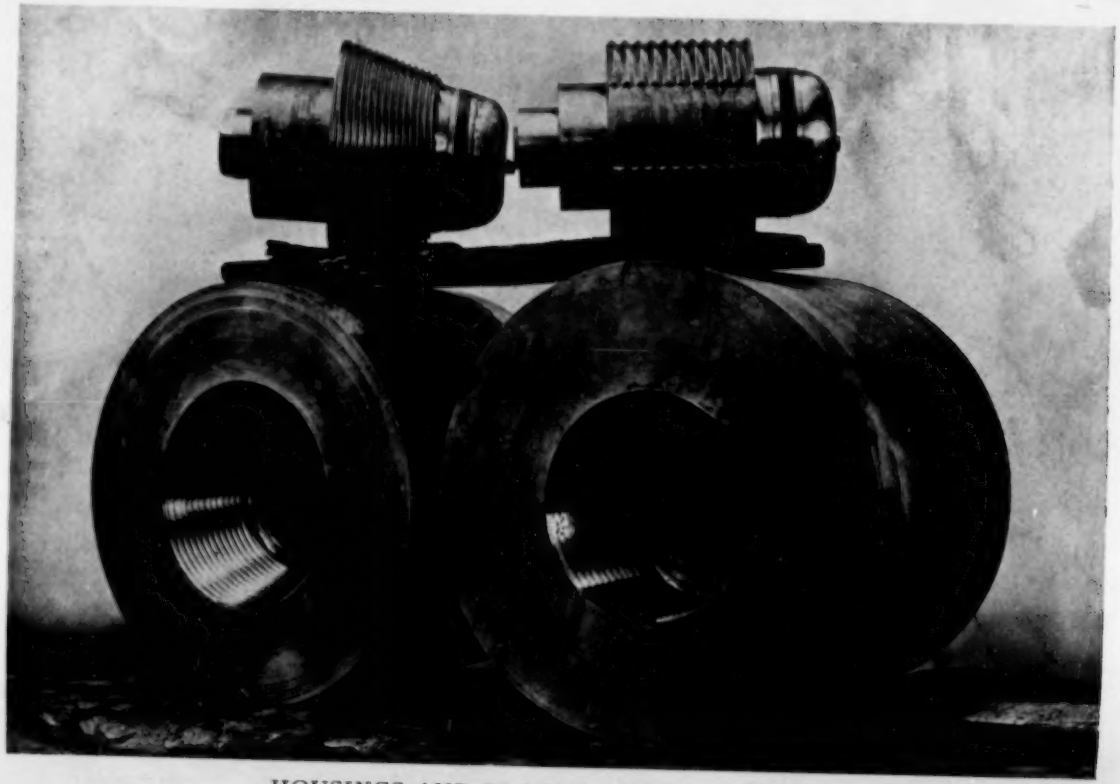
BETHLEHEM STEEL COMPANY.

TEST OF CONICAL AND CYLINDRICAL BREECH BLOCKS (THREADS COMPLETE). SHEET 1, *February*, 1900.

Threaded area of conical block, 93 square inches. Weight of threaded portion of conical block, 53 lbs.

" " cylindrical " 66 " " " " " cylindrical " 74 "

	Pressure.	Powder chamber.			Housing.		Distance from bottom of rearmost thread of plug to tops of threads so selected as to show effect of compression of plug given in inches.				Remarks.
		Inside diameter.		Length between points.	Enlargement of outside diameter.	After pressure.					
		Front.	Rear.		During pressure.		1	2	3	4	
CONICAL PLUG.	0	5.505	5.5005	1.28	....	0	3.561	....	....	..	Plug screwed home to a stop.
	30000	5.505	5.5005	1.28	0.001	0	3.564	....	....	..	Thread bent on account of inaccuracy in cutting the same.
	40000	5.5055	5.501	1.28	0.002	0	3.565	....	....	..	
	45000	5.5075	5.5035	1.28	....	..	3.565	....	....	..	Opened with some difficulty.
	32500	5.5075	5.5035	1.28	....	..	3.565	....	....	..	Plug in this and following tests screwed home to within 6° of a stop. No sticking.
	35000	5.5075	5.5035	1.28	0.0015	0	3.565	....	....	..	Opened with great ease.
	37500	5.5075	5.5035	1.28	....	..	3.565	....	....	..	Opened with great ease.
	54000	5.5085	5.5055	1.2825	....	..	3.565	....	....	..	Opened with great ease, plug marked by gas check ring.
CYLINDRICAL PLUG.	0	5.4975	5.4995	1.28	....	..	4.739	3.748	2.754	..	
	30000	5.4975	5.4995	1.28	0.001	0	4.739	3.748	2.754	..	
	35000	5.4975	5.5000	1.28	0.0015	0	4.739	3.749	2.755	..	
	30000	5.4975	5.5000	1.28	0.001	0	4.740	3.749	2.756	..	
	37500	5.4975	5.5000	1.28	0.00175	0	....	....	....	..	
	40000	5.4980	5.5010	1.28	0.002	0	4.741	3.749	2.756	..	
	45000	5.5005	5.5025	1.28	0.0023	0	4.744	3.749	2.757	.	Opened with some difficulty.
	50000	5.5010	5.5027	1.282	0.0025	0	4.745	3.751	2.757	..	Opened with some difficulty.
	54000	5.5025	5.5040	1.2825	....	..	4.745	3.752	2.757	..	Opened with some difficulty.



HOUSINGS AND BLOCKS BEFORE TESTING.

HOUSINGS AND BLOCKS BEFORE TESTING.

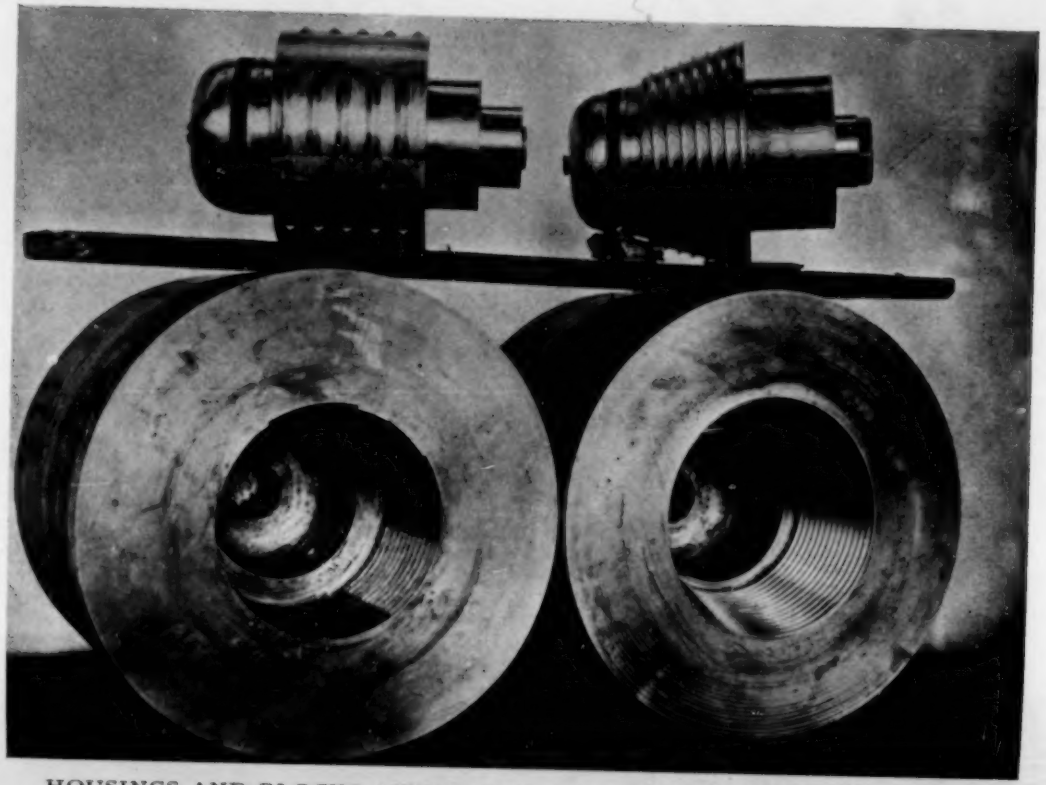
BETHLEHEM STEEL COMPANY.

TEST OF CONICAL AND CYLINDRICAL BREECH BLOCKS (ONE HALF OF THREADS REMOVED).

SHEET 2, *February*, 1900.

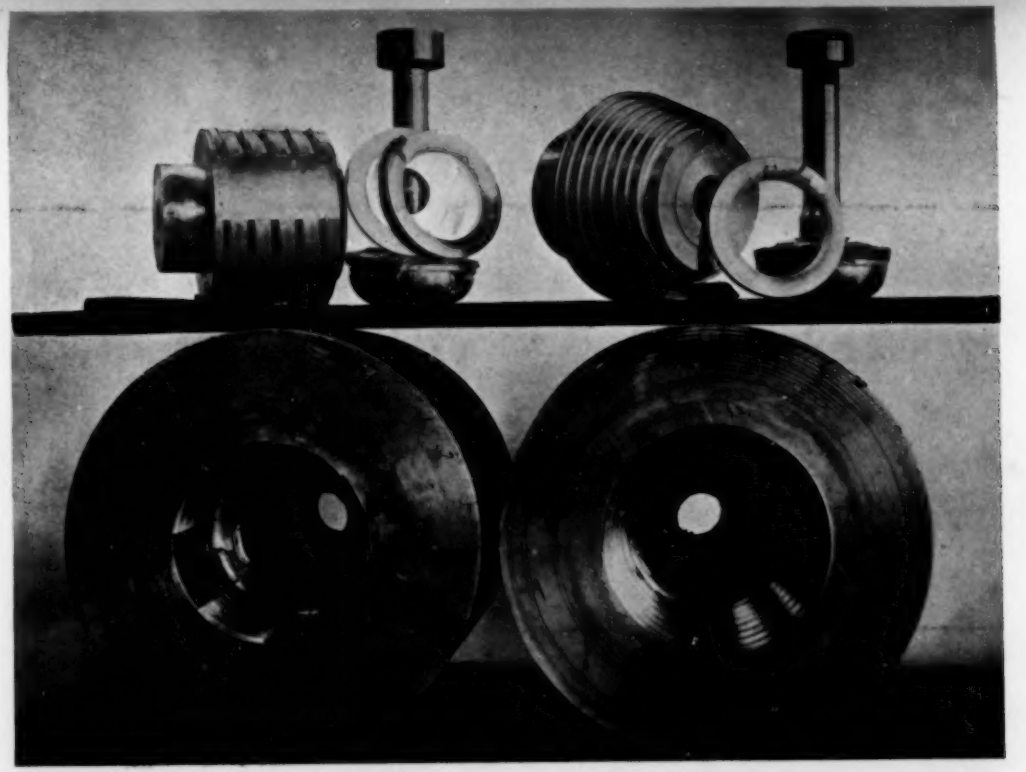
Threaded area of conical block, 46.5 square inches. Weight of threaded portion of conical block, 53 lbs.
" " cylindrical " 33 " " " " " cylindrical " 74 "

	Pressure.		Powder chamber.			Distance from bottom of rearmost thread of plug to tops of threads so selected as to show effect of compression of plug given in inches.				Remarks.
			Inside diameter.							
	Actual.	Corresponding to full area of threads.	Front.	Back.	Length between points.	1	2	3	4	
CONICAL PLUG.	0	0	....	....	....	3.565	2.420	1.272	....	Opened with great ease.
	30000	60000	....	....	....	3.565	2.420	1.272	....	" " " "
	35000	70000	....	....	....	3.565	2.420	1.272	....	" " " "
	40000	80300	....	....	....	3.566	2.420	1.274	....	" " " "
	45000	90000	....	....	....	3.572	2.425	1.280	....	Opened with ease.
	50000	100000	....	....	....	3.578	2.433	1.288	....	Opened with some difficulty.
	55000	110000	5.5100	4.5065	....	Threads destroyed in gun by shearing.				Opened with great difficulty, circumference of screw forced 0.01" to the rear.
CYLINDRICAL PLUG.	0	0	....	....	....	4.263	3.261	2.269	1.265	New threads marked.
	30000	60000	....	....	....	4.265	3.261	2.269	1.265	Opened with difficulty.
	35000	70000	....	....	....	4.266	3.263	2.271	1.268	" " "
	40000	80000	....	....	....	4.267	3.266	2.271	1.268	" " "
	45000	86000	....	....	....	4.271	3.270	2.277	1.271	Opened with increasing difficulty as the tests became more severe.
	48000	96000	....	....	....	4.276	3.274	2.280	1.272	
	52000	104000	....	....	....	4.293	3.288	2.292	1.285	Threaded sectors forced 0.015" to the rear.
	58000	116000	....	....	....	Plug forced 0.1" to the rear.				" " " 0.02" " "
	62500	125000	5.506	5.509	....	Thread in gun and plug destroyed by bending.				" " " 0.035" " "
										Rear gas check ring spread, forcing itself into the gas check seat.



HOUSINGS AND BLOCKS AFTER TEST WITH FULL THREAD ON BLOCKS.
BLOCKS WITH ONE-HALF THREAD CUT AWAY.

HOUSINGS AND BLOCKS AFTER TEST WITH FULL THREAD ON BLOCKS.
BLOCKS WITH ONE-HALF THREAD CUT AWAY.



HOUSINGS AND BLOCKS AFTER TESTING.
BLOCKS DISMOUNTED SHOWING EFFECT OF TEST.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NOTES ON THE METHOD OF MAKING THE SCALE FOR A 24-INCH SOUNDING TUBE OF THE TANNER-BLISH PATTERN.

By LIEUTENANT H. E. PARMENTER, U. S. Navy.

The mean of a number of determinations of serial specific gravities of sea-water taken at different times and in various parts of the world by the U. S. F. C. S. Albatross give the specific gravity reduced to 60° F. at the surface as 1.02678, at 100 fathoms as 1.02715 and at 200 fathoms as 1.02718. With these values, corrected for temperature, the weight of the column of water for the different depths was computed. The volume occupied by the air at the different depths was then computed by Boyles' law. The heat generated by the compression of the air was assumed as dissipated by the surrounding water.

The mean of the temperatures of the sea-water at 100 fathoms taken at 121 stations where serial temperatures were taken, and 174 stations where it was the bottom, a total of 295 stations, gave the temperature as 50°.9 F., the air at the same time averaging 67°.4 F. and the water at the surface 64°.9 F. This giving a difference of 16°.5 F. between the temperature of the air and the sea-water at a depth of 100 fathoms.

The temperature of the sea-water at 200 fathoms taken at 89 stations where serial temperatures were taken, and at 101 stations where it was the bottom, a total of 190 stations, gave the temperature as 47°.7 F., the air at the same time averaging 68°.2 F., and the water at the surface 67°.4 F. These temperatures and soundings were taken by the U. S. F. C. S. Albatross from 1883 to 1892 in various parts of the world. Air contracts in volume at the rate of 1/491.2 for each degree Fahr. decrease in temperature.

This correction for contraction of volume due to change in temperature was next made. The next correction is that due to the absorption of the air under pressure, by the sea-water.

The law that the weight of a gas absorbed is proportional to the pressure is not fully carried out in this case because the law is based on the assumption that the volume of gas is greatly in excess of the liquid and that the pressure is maintained until the absorption has reached its limit, neither of which conditions are satisfied in taking soundings.

At 50°.9 F. water by the above law will absorb 0.01936 of its volume of air.

The result of 36 tests made with sounding tubes on the U. S. S. Prairie in July, 1900, indicates that at 100 fathoms, the absorption of the volume of air in the tube was 0.13 per cent and at 5 fathoms the absorption was 0.04 per cent. Using these two values as limits the values for other depths were easily found, and these values were used for the third correction. The length of the volume of air in the tube due to pressure produced by the column of water at the various depths is as follows:

Fathoms	Inches	Fathoms	Inches	Fathoms	Inches
0	24,000	22	4,495	50	2,133
5	12,020	23	4,335	52	2,057
6	10,940	24	4,180	54	1,982
7	10,060	25	4,040	56	1,915
8	9,320	26	3,904	58	1,850
9	8,658	27	3,781	60	1,785
10	8,090	28	3,661	62	1,725
11	7,590	29	3,552	64	1,671
12	7,160	30	3,441	66	1,621
13	6,770	32	3,252	68	1,573
14	6,400	34	3,088	70	1,522
15	6,078	36	2,919	75	1,420
16	5,785	38	2,779	80	1,327
17	5,520	40	2,650	85	1,251
18	5,285	42	2,530	90	1,178
19	5,070	44	2,420	95	1,112
20	4,860	46	2,320	100	1,049
21	4,670	48	2,223		

DISCUSSION.

Captain Chadwick's Letter Relating to the Training of Seamen. See No. 98.

Commander H. O. Rittenhouse.—I ask the privilege of contributing a few words in opposition to the conclusions reached by those who favor the continued use of sailing ships.

As a basis for my argument I quote from the remarks of Captain Goodrich in his discussion (see No. 100), "the navy is to-day what it is because of what it has been." This statement is epigrammatic and embodies in the terse language characteristic of the author the fundamental support of nearly every contention that has been advanced for the continuation of sail experience since the introduction of steam developed the issue. Moreover the statement is unassailable in point of fact. It is, however, not the whole truth, nor do I believe it to be the most important part of the whole truth. Herein lies the danger of our being misled in judgment. Manifest error is quickly detected; but a part only of the truth, usurping the place of the whole, may lead to wrong conclusions. "Has been" embraces a long while ago. How many centuries before the days of the Phoenicians we may never know. Yet it cannot be denied that the navy is to-day what it is because of the Phoenician navigators. There is many a strain of their skill found in our inheritance to-day. But would it be useful therefore to build galleys and train men to the galley oar because of such fact? It cannot be denied that the navy is to-day what it is because of Columbus, of Vasco De Gama, Magellan, Drake, and hosts of others with their caravels and galleons. It cannot be denied that the navy is to-day what it is, because of Nelson, his contemporaries, and their fleets. Still less can it be denied that our navy is to-day what it is because of American heroes from Paul Jones downward, the American-built ships that made our constructors famous, and the ordnance and equipment they carried.

While thus the navy contains elements from all these sources of the past, it unquestionably owes more to what it has been in the *immediate* past than to what it has been in the *remote* past. This is simply because of development. It is not a mere law of development. It is development itself. The new of to-day must come directly from the conditions of yesterday. The composition of our navy at this moment contains far more of the new that has displaced the old, than it does of the old that has been retained. I regard it therefore as a more comprehensive and a safer truth to follow in discussion, to say that the navy is what it is to-day because of Ericsson's monitor, because of modern steel production, and because of the battles of Manila and Santiago.

In providing for the needs of the navy of to-morrow we will be best guided by noting the requirements of the navy of to-day. Among these

I do not find yards and sails, nor do I find chocking quoins or handspikes. I see no strong necessity for working along any of these lines. I believe greater progress will be made and wiser preparation for the future by using every effort to educate and train men directly to the *care, preservation and use* of all the mechanical devices and equipment found on service ships from the main engines and their appurtenances, down to the simplest electrical connection.

I wish to express my entire agreement with all those who regard the old time man-of-war topman as a type embodying in the highest degree the qualities of "courage, resourcefulness, activity, strength," etc. But in the development of these, or any other desirable qualities in man, there must be a spiritual motive behind, or underneath the efforts, else the development will fail. Does any one believe for a moment that such qualities could have been developed if the masts and sails had not been a necessity of the man's environment? Would they have been developed if the masts and sails had been of no use to the ship but were carried along for mere gymnastics? Was it possible to arouse enthusiasm in either officers or men regarding the battery drill, when for years we were forced to carry old smoothbores on Marsilly carriages, while other navies had rifled guns and mechanical mounts?

The duties of a fireman in the fire department of any of our large cities require exactly such qualities as have been named. But is it anywhere advocated that to obtain such men a sailing cruise is necessary? Exactly such qualities are needed in the army; but their recruits are not sent to sea. Now what are the facts in these professions? There are no braver, handier, no more skillful men anywhere than can be found in the fire departments of our large cities. A similar statement can be made of the army, and of the organized police and other forces. These men are trained directly to do the very things for which they are wanted. They realize the usefulness and necessity of their work, there is a spiritual prompting to effort; and, it results that in them is, of necessity, developed the peculiar kinds of courage, resourcefulness, activity, and strength that their professions demand. In the future needs of the navy it will be precisely the same. When a man of courage and strength is required to haul a fire in an emergency he will be found among those who have had their beards singed in such experiences before. When one is needed to start up a dynamo for light or power in the peril of a collision or other disaster, among those familiar with the valves and switches will be found the man of resourcefulness and skill to overcome obstacles and accomplish his work. Throughout each and every department of the ship, if the men do not get the old-time facility and training by doing the old-time work, it merely proves that the old-time work is no longer necessary; and where there is so much to learn that is new and necessary it seems unwise to devote any time to that which has been abandoned in actual service. I would emphasize the fact that courage is not like a material object that can be turned out to order by a machine and thenceforward be carried about in a kit to be applied to any occasion on demand. On the contrary, it is, in the highest degree,

of a spiritual nature, and may be cultivated and developed in any field of endeavor where high standards of duty are set up and men urged and encouraged to live up to them.

Why should we assume that intelligent specialists will be helpless "in the presence of phenomena different . . . from those with which they are habitually concerned"? It can hardly be merely because they are specialists; for if ever there was a person that could properly be so characterized it was the old-time sailor. Moreover, if any reliance can be placed upon tradition, or even upon the memory of men now living, we must believe that the tarry topman himself sometimes became helpless when he encountered phenomena of an unaccustomed character. In our desire to avoid narrow specialties are we to go to the other extreme and spend time and effort in this pressing age to educate men to meet conditions avowedly different from those for which they are wanted?

As long as pulling boats are necessary to the service of a man-of-war we may confidently rely upon both officers and men to have proficient oarsmen among the crew. It is difficult to see how any amount of sail drill previous to, or during, general service would improve the skill of the oarsmen. As long as tugs, torpedo boats, lighters and other small craft are, of necessity, associated with our ships we will have men who can throw a line as adroitly as could Benbow himself. Here again, if our modern ships carried sails, it is difficult to see how that particular fact would contribute much to improvement.

It would seem in following the discussion that there is a frequent tendency to regard knowledge and skill in the use of spars and sails as the full and exact equivalent of seamanship. If such were the fact one could well understand and sympathize with the fear that should sails be entirely abandoned, then indeed there would be no more seamen, no more seamanship, and all would be lost. But it is far from the fact. So long as men go to sea, whether in sailing ships, in mastless steamers, or in submarine, there will be seamen and there will be seamanship. He who is master of his craft and of the conditions of its use will be a seaman. The art and the science that produce such mastery will be seamanship. It is one thing to-day and may be another to-morrow; and if, for example, in the development of the submarine, sails should be found necessary to its efficient operation, men might well receive a preparatory training on sailing ships, but if they are not carried it would seem unreasonable to insist upon such training.

PROFESSIONAL NOTES.

Prepared by Lieutenant L. S. Van Duzer, U. S. Navy.

For convenience of reference these notes are arranged as follows:

A. Notes on ships of war, budgets, and personnel, the notes appearing under the head of the naval power to which they refer. Alphabetical arrangement is followed.

B. Miscellaneous Notes on Armor, Ordnance, Explosives, Torpedoes, etc. The arrangement is alphabetical and the principal heads are:

1. Ammunition.
2. Armor.
3. Boats.
4. Boilers.
5. Canals, Harbors, and Waterways.
6. Coaling Ship.
7. Coast Defense.
8. Communications.
9. Construction.
10. Docks.
11. Electricity.
12. Engines.
13. Fortifications.
14. Fuel.
15. Gunpowder and Explosives.
16. Guns.
17. Guns: Firing.
18. Guns: Mounts.
19. Instruments Used in Action, etc.
20. Machinery (auxiliary engines), etc.
21. Operations (war or manoeuvers).
22. Propulsion.
23. Small Arms.
24. Strategy and Tactics.
25. Torpedoes.

SHIPS OF WAR, BUDGETS AND PERSONNEL.

ARGENTINA.

Personnel.—The executive officers on the active list of the Argentine navy consist of 1 vice-admiral, 4 rear-admirals, 16 captains, 57 commanders, 52 senior lieutenants, 76 junior lieutenants, 28 senior ensigns, 82 junior ensigns, and 34 midshipmen.

General Roca and General Mitra: Ordered.—The Argentine government has ordered two more armored cruisers in Italy. They will be of the Garibaldi type but larger, the designed displacement being 8500 tons, I. H. P. 17,000, and speed 21 knots. They are to be named General Roca and General Mitra. A large premium is offered for completion before the end of the contract time.

Plata, Andes: Reconstruction.—The old single-turreted monitors Plata and Andes (1677 tons, launched in 1875) are being extensively repaired and refitted.

Submarine Boat Ricaldoni.—It is reported that the submarine boat Ricaldoni is under construction in Buenos Aires. Its length is stated to be 131.2 feet; beam, 16.4 feet; speed, 11 knots; and radius of action, 435 miles.

AUSTRIA.

VESSELS BUILDING.

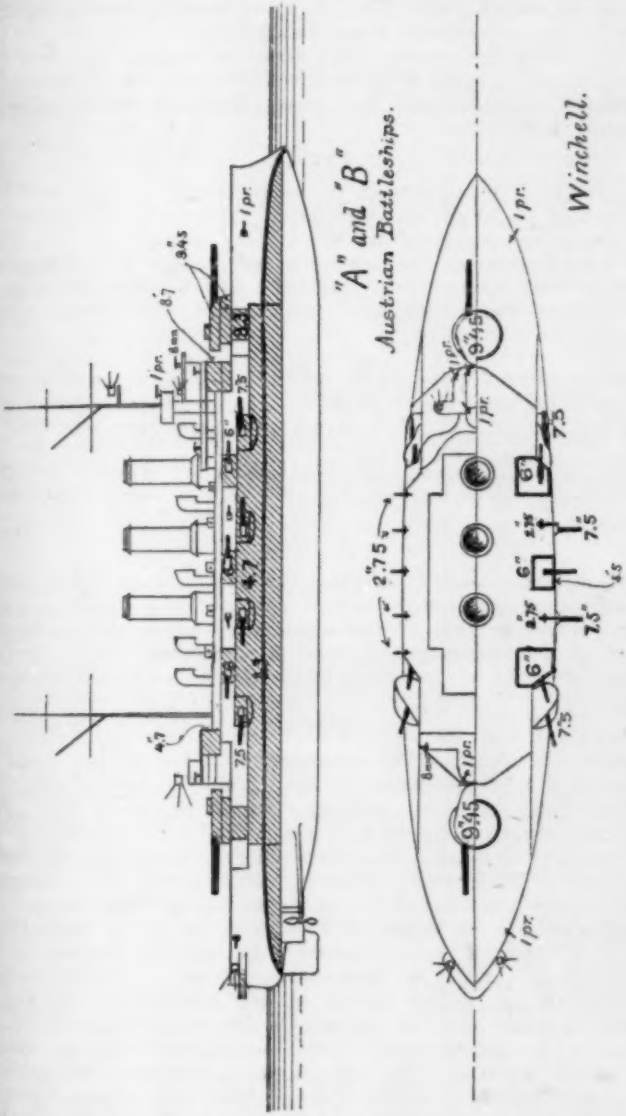
Name.	Displacement, tons.	Where building.	Remarks; date of completion.
Battleships.			
A (ersatz-Loudon)....	10,600		Building.
B (ersatz-Drache)....	10,600		Ordered.
Babenberg.....	8,340	Pola.	Building; to be lchd. 1902.
Arpad	8,340	Trieste.	Launched Sept. 9, 1900.
Habsburg.....	8,340	"	Launched Sept. 11, 1901.
Armored Cruiser.			
E (ersatz-Radetzky).	7,400		Building.
Protected Cruiser.			
Szigetvar.....	2,350	Pola.	Launched Oct. 29, 1900; nearly completed.
River Monitors.			
I.....	450		Building.
II.....	450		"

BATTLESHIPS A AND B: DESCRIPTION.—These new battleships A and B (see plans on opposite page), authorized in the budgets for 1901 and 1902 respectively, are supposed in theory to replace the Loudon and Drache (though the latter are merely small unarmored cruisers), and they are therefore temporarily styled ersatz-Loudon and ersatz-Drache. Their design is a development of the Habsburg type with heavier guns and somewhat thicker armor, though the belt is not continued to the stem. The freeboard is moderately high—15 or 16 feet aft and 17 or 18 feet forward. A central superstructure, one deck high, rises above the main deck amidships and is the full width of the ship; above its forward and after ends are commodious bridge decks. There are two masts; the forward one is of military type, but short, and carries a single military top, above which there is a light mast carrying a search-light platform, two signal yards and a gaff; the after mast is a light one carrying two signal yards and a gaff. There are three smokepipes on the fore-and-aft midship line, and a heavy boat crane on each side serves to handle the boats. The principal details are:

Armament.—Four 9.45-inch, 40-caliber Skoda guns in pairs in turrets on the main deck forward and aft. Eight 7.48-inch, 42-caliber Skoda guns in sponsons on the gun deck, four each side, forward pair firing directly ahead and after pair directly astern, the ship's side being cut away forward and aft above the gun deck to permit of firing ahead and astern. Six 5.87-inch, 52-caliber Skoda guns in armored sponsons on the main deck in the superstructure, three each side. Fourteen 2.6-inch (45-caliber or 60-caliber) Skoda guns, of which ten are in broadside on the upper deck. Twelve 1-pounders; one on each side forward and aft on the gun deck; two each side on the forward bridge deck; two in the military top and two on the after bridge deck. Four 8-millimeter machine guns; one each side on the after bridge deck and two at the forward end of the upper forward bridge deck. One submerged torpedo tube.

Protection.—Partial water-line belt 8.27 inches thick at the water-line throughout, extending far enough to protect the bases of the turrets by means of a thwartship bulkhead of the same thickness. Above this belt the side is armored up to the main deck from the forward 7.48-inch

gun to the after one; the thickness is 4.7 inches. The protective deck is 1.97 inches thick inside the belt and 2.76 inches before and abaft the



transverse armor bulkheads. The turrets of the 9.45-inch guns are 9.45 inches thick; they are supported by armored towers above the main deck and very large loading tubes below—the former 9.45 inches thick

and the latter 8.27 inches. The side over the 7.48-inch guns is 4.7 inches thick but the sponson plating is thicker. The sponsons of the 5.87-inch guns are 5.5 inches thick. There are two conning towers, the forward one 8.7 inches thick and the after one 4.7 inches.

Motive Power.—Twin-screw, triple-expansion engines of 14,000 I. H. P., designed to give a speed of 19 knots. Yarrow water-tube boilers.

Dimensions.—Length, 390.4 feet; beam, 72.16 feet; draft, 24.6 feet; displacement, 10,600 tons.

CHILE.

CHACABUCO: PURCHASED.—A protected cruiser of 4500 tons, building at the works of Sir W. G. Armstrong, Whitworth & Company, Newcastle, has been purchased by the Chilean government and is to be called the Chacabuco. The armament will consist of two 8-inch guns, twelve 4.7-inch, sixteen small rapid-fire and machine guns, and four torpedo tubes (two of which are submerged). The designed speed is 22.5 knots.

TORPEDO-BOAT DESTROYERS: BUILDING.—The two torpedo-boat destroyers of 321 tons, 6250 I. H. P., and 30 knots speed, building at the works of Laird Brothers, Birkenhead, have been launched.

PILCOMAYO: REPAIRING.—The old wooden gunboat Pilcomayo (600 tons) is being extensively repaired at Talcahuano and will receive new boilers.

CHINA.

SALE OF VESSELS.—It is said that the Chinese government regards its navy as a costly and nearly useless defence. The burden is especially felt at present because of the indemnities which are to be paid on account of the Boxer uprising, and it is reported that a part of the Russian indemnity will be settled by the transfer of vessels of the Canton flotilla.

DENMARK.

BUDGET FOR 1901-02.—The total amount of the Danish naval budget for 1901-02 is 6,796,495 crowns ($1,821,460.66—1 crown = $0.268), which is 54,954 crowns less than the amount for the preceding year. The sum of 5,134,144 crowns is for the navy proper and 1,662,351 for the expenses of the ministry of marine, dependent offices, schools, etc. The principal items are: 1. Ministry of marine, 94,134 crowns; 2. Pay and other expenses for the personnel of the navy, 795,372; 3. Expenses of arsenals, including material, 2,877,240; 4. Provisions, 40,333; 5. Medical service, 49,000; 6. Clothing, 63,534; 7. Quarters, 113,041; 8. Dredging; 9. Schools of instruction, 121,761; 10. Armaments, 941,900; 11. Miscellaneous expenses, 97,736; 12. Instruction of enlisted men, 80; 13. Pensions, 834; Archives of nautical charts, 36,190. In Chapter 3, expenses of arsenals is given the credits for new construction which is 1,215,000 crowns, the same as for last year. The construction work comprises the building of the small battleship Olfert Fischer (4200 tons, a sister ship to the Herluf Trolle), the reconstruction of the brig Oernen, which is to be used as a training ship for cadets, repairs to the surveying steamer Krieger and the mine boats A, B, and No. 2, and new boilers for the gunboat Guldborgsund. Among the other large items are 99,000 crowns

for the purchase of torpedo mines and 126,000 crowns for the equipment and supplies of the Herluf Trolle.

FRANCE.

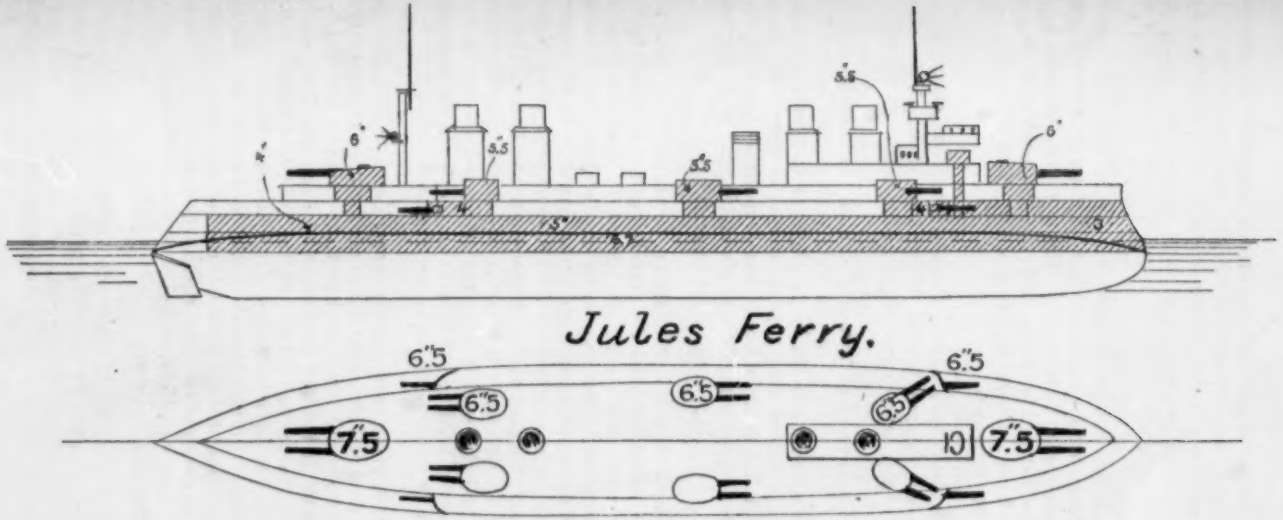
VESSELS BUILDING.

Name.	Displacement, tons.	Where building.	Remarks; date of launch; probable date of completion, etc.
Battleships.			
A_{11}	14,865		Not yet ordered.
République	14,865	Arsenal, Brest.	To be laid down early in 1902.
Patrie	14,865	Private yard.	Not yet commenced.
Suffren	12,728	Arsenal, Brest.	Launched, compl., 1902.
Iéna	12,052	" "	Practically completed.
Henri IV	8,948	" Cherbourg.	Launched, ready for trials.
Armored Cruisers.			
C_{14}	12,550	Arsenal, Brest.	Ordered.
C_{15}	12,550		Not yet ordered.
Jules Ferry	12,550	" Cherbourg.	Not yet lchd.; compl., 1904.
Victor Hugo	12,550	" Toulon.	Not yet lchd.; compl., 1904.
Léon Gambetta	12,550	" Brest.	Lchd. Oct. 26, '01; compl. 1904.
Jeanne d'Arc	11,270	" Toulon.	Lchd. 1899; unsatisfactory.
Gloire	10,000	" Lorient.	Lchd. 1900; complete 1903.
Marseillaise	10,000	" Brest.	Lchd. 1900; complete 1902.
Amiral Aube	10,000	Ch. de la Loire, St. Nazaire.	Not lchd.; complete 1903.
Sully	10,000	Forges et Chantiers de la Mediterranée La Seyne.	Lchd. June 4, '01; compl. '03.
Condé	10,000	Arsenal, Lorient.	Lchd. Mch. 8, '02; compl. '03.
Amiral Gueydon	9,516	" "	Lchd. 1899; complete 1902.
Dupetit Thouars	9,516	" Toulon.	Lchd. July 5, '01; compl. '03.
Montcalm	9,516	F. et C. de la M., La Seyne.	Lchd. Mch. 28, '00; compl. '02.
Desaix	7,700	Ch. de la L., St. Nazaire.	Lchd. Mch. 21, '01; compl. '03.
Dupleix	7,700	Arsenal, Rochefort.	Lchd. Apr. 28, '00; compl. '03.
Kléber	7,700	Ateliers de la Gironde, Bordeaux.	Not lchd.; complete 1903.
Protected Cruisers.			
Jurien de la Graviere	5,500	Arsenal, Lorient.	Lchd. 1899; complete 1902.
Chateaurénault	8,018	F. et C. de la M., La Seyne.	Not yet accepted; machinery troubles.
Transport.			
Vaucluse	1,650	Arsenal, Rochefort.	Lchd. compl. 1902.
Torpedo Boat Destroyers.			
Pertuisane	303	Arsenal, Rochefort.	Lchd. Dec. 5, '00; compl. '02.
Escopette	303	" "	Lchd. Dec. 20, '00; compl. '02.
Flamberge	303	" "	Lchd. Oct. 28, '01; compl. '03
Rapière	303	" "	Lchd. July 16, '01; compl. '02.
Sarbacane	303	" "	Laid down 1901.
Carabine	303	" "	"
Francisque	303	" "	Ordered.
Sabre	303	" "	"
Arquebuse	303	A. Normand et Cie., Havre.	Complete 1903.
Arbalète	303	" "	"
Mousquet	303	" "	"
Sagaie	303	" "	"
Epieu	303	" "	"
Harpon	303	" "	"

VESSELS BUILDING—*Continued.*

Name.	Displacement, tons.	Where building.	Remarks; date of launch probable date of completion, etc.
Fronde	303	A. Normand et Cie., Havre.	Complete 1903.
Javeline	303	" "	"
Bombarde	303	" "	"
Catapulte	303	" "	"
Dard	303	(?) Rouen.	Ordered.
Baliste	303	(?) "	"
Mousqueton	303	Creusot Works, Chalons.	"
Arc	303	" "	"
Pistolet	303	Ch. de la Loire, Nantes.	"
Bélier	303	" "	"
Torpedo Boats.			
Rafale	162	A. Normand et C., Havre.	Undergoing trials.
255, 256, 257	90.6	F. et C. de la M., "	Complete 1902.
259, 260, 261	90	At. de la Gironde, Bor.	"
262, 263	86 to 90	Creusot Wks., Chalons.	"
264, 265	90	Dyle et Bacalan, Bor.	"
266 to 268	87	?	Ordered.
269, 270	91	Normand, Havre.	"
271, 272	89	Creusot Wks., Chalons.	"
273, 274	91	Dyle et Bacalan, Bor.	"
275, 276	90	At. de la Gironde, Bor.	"
277	90	Arsenal, Saigon.	"
Libellule	40	Normand, Havre.	Building (turbine boat).
Submarine Boats.			
Farfadet	185	Arsenal, Rochefort.	Lchd. May 17, '01; compl. '02.
Gnome	185	" "	Not yet launched.
Korrigan	185	" "	Lchd. Jan. 25, '02; compl. '02.
Lutin	185	" "	Launched; complete, 1902.
Perle	70	" Toulon.	Ordered in 1901.
Bonite	70	" "	"
Esturgeon	70	" "	"
Thon	70	" "	"
Souffleur	70	" "	"
Anquille	70	" "	"
Aloze	70	" "	"
Dorade	70	" "	"
Truite	70	" "	"
Grondin	70	" "	"
Naide	68	" Cherbourg.	"
Protée	68	" "	"
Lynx	68	" "	"
Ludion	68	" "	"
Loutre	70	" Rochefort.	"
Castor	70	" "	"
Phoque	70	" "	"
Otarie	70	" "	"
Méduse	70	" "	"
Ourain	70	" "	"
Q_{26}		" Cherbourg.	Ordered 1901; experimental.
Q_{36}		" Rochefort.	" "
Q_{37}		" Toulon.	" "

BUDGET FOR 1902: REMARKS.—The naval budget for 1902 has not yet been approved by the French Chambers. It should provide for laying



For description of the Jules Ferry, see description of Victor Hugo, a sister ship, in PROCEEDINGS No. 98, page 384.

down and completing vessels in accordance with the six-year program approved two years ago, but the Budget Committee have declined to sanction the very small appropriations asked for battleships A12, A13, and A14. This in itself would not be very serious but part of the fight against the commencement of these ships was led by the members who are opposed to building any battleships and they may succeed in defeating the appropriations for them next year by joining with the deputies who advocate delay for financial reasons. France is barely holding her place as the second naval power and in the next ten years she is likely to be outstripped by Russia, Germany and the United States, as the financial condition of these powers is likely to improve while that of France seems to be about stationary.

CONDÉ: LAUNCH.—The armored cruiser Condé is to be launched at the arsenal, Lorient, March 8. She is the last of the Gloire class to be laid down and is fully described in PROCEEDINGS No. 97, p. 156.

MONTCALM: TRIALS.—This armored cruiser had satisfactory trials in November last. The results of the full power trial were: I. H. P., 19,799; coal consumed per I. H. P. per hour, 1.89 pounds; speed, 21.087 knots. See PROCEEDINGS No. 100, page 754, in regard to temperature of fire rooms. A full description of the Dupetit Thouars, a sister ship to the Montcalm, is given in PROCEEDINGS No. 99, page 590, and a full page illustration of the Montcalm faces page 755 in No. 100.

CHATEAURENAULT: TO BE PLACED IN SERVICE.—This fast protected cruiser is to be commissioned for service and will join the northern squadron. Her full-power trials are given in PROCEEDINGS No. 100, page 754, together with remarks upon the heat in the fire-rooms. A six-hour trial, which took place in January, gave: I. H. P., 18,400; speed, 21.9 knots; coal consumed per I. H. P. per hour, 1.41 pounds. No attempt was made to exceed the horsepower developed, the object of the trial being to ascertain the behavior of the machinery at about 18,200 I. H. P., and the trial is reported to have been satisfactory in all respects. A 24-hour trial at full power was designed to take place early in February but no reports of it are yet received.

REQUIN: RECONSTRUCTION COMPLETED, TRIAL.—The alterations and repairs of the coast defence ship Requin (about 7000 tons displacement since reconstruction) are completed and she recently finished her steam trials. With eight of her ten boilers (Niclausse) the I. H. P. developed was 6350 and the speed 15.3 knots; all the motive machinery and appliances gave entire satisfaction. The battery of the Requin now consists of 274.4-millimeter (10.8-inch) guns in closed turrets, one forward, one aft; six 3.9-inch rapid-firing guns in the central battery, four at the corners of the superstructure and two in broadside; eight small rapid-firing guns and twelve machine guns. See also PROCEEDINGS No. 97, page 159, and No. 100, page 754.

INDOMPTABLE, CAIMAN: ALTERATION.—These two coast defence vessels are sister ships to the Requin (see preceding paragraph) and similar alterations in the Indomptable are completed and she will shortly undergo her machinery trials. See PROCEEDINGS No. 100, page 755. The alterations to the Caiman are still in progress.

DUQUESNE, TOURVILLE, IPHIGÉNIE: NAMES STRUCK FROM LIST.—The names of the old cruisers Duquesne, Tourville and Iphigénie are to be struck from the list of the fleet.

PISTOLET, BÉLIER: ORDERED.—The torpedo-boat destroyers Pistolet and Bélier have been ordered of the Ateliers et Chantiers de la Loire, Nantes. For description, see PROCEEDINGS No. 98, page 386.

FLAMBERGE: LAUNCH.—The torpedo-boat destroyer Flamberge, 303 tons, was launched at the arsenal, Rochefort, October 28, 1901. She is a sister ship in all respects to the Pertuisane and Escopette, a description of which is given in PROCEEDINGS No. 97, page 157.

BOURRASQUE: TRIALS.—The torpedo boat Bourrasque, 162 tons, and which is fully described in PROCEEDINGS No. 100, page 755, has completed her trials. On the full-power trial the mean speed maintained for one hour was 31.53 knots with 347 revolutions. On her coal consumption trial at a speed of 14.365 knots, the amount of coal used was 602.7 pounds per hour.

TORPEDO BOAT NO. 254: TRIAL.—This boat finished her trials in November. The results on the one-hour full-speed test were 25.015 knots and 342 revolutions. For details of No. 254, see PROCEEDINGS No. 100, page 757.

TORPEDO BOATS 255 AND 256: LAUNCH, DESCRIPTION, TRIAL OF NO. 255.—These two boats, which were built at the yard of the Forges et Chantiers de la Mediterranée, Havre, are practically completed. No. 255 was launched on October 31 and No. 256 on November 29. No. 255 has completed her trials satisfactorily; the mean speed for the one-hour run was 25.61 knots with 345.25 revolutions. The dimensions of No. 256 are: Length, 121.4 feet; beam, 13.2 feet; draft, aft, 8.9 feet; displacement, 90.65 tons. The armament consists of two torpedo tubes and two 1-pounders. The engines drive a single-screw and are designed to develop 1800 I. H. P. and give a speed of 24 knots; the boilers, two in number, are of the Normand type; the coal supply (in the form of briquettes) is 12.5 tons. No. 256 and No. 257 are somewhat stronger in construction than the three preceding numbers built by the same company and have 8 inches less beam and 4 inches more draft, but they are otherwise practically the same.

TORPEDO BOATS 259 AND 260: LAUNCH.—These boats are building at the yard of the Ateliers et Chantiers de la Gironde, Bordeaux. No. 260 was launched October 31 and No. 259 a few days earlier. They differ from No. 256 (see preceding paragraph) in having one meter (3.28 feet) greater length, in having Du Temple-Guyot boilers instead of Normand, and in having machinery of which the designed I. H. P. is supposed to be 300 less; but since the designed speed is the same the power on trial will probably be not very different.

TORPEDO BOAT 264: READY FOR TRIALS.—This boat, which was built at the yard of Messrs. Dyle and Bacalan, Bordeaux, is reported ready for trials. Her details are the same as those of No. 256 (see second preceding paragraph) except that she has 4 inches less draft and about half a ton less displacement.

KORRIGAN: LAUNCH.—The submarine boat Korrigan of the Morse type was launched at Rochefort arsenal January 25. The dimensions and certain details of the Farfadet, a sister boat in all respects, are given in PROCEEDINGS No. 98, page 387.

ESPADON, SILURE: TRIALS.—These two submergible boats of the Narval type have been undergoing trials. The Espadon is able to submerge itself in six minutes after steaming along the surface as an ordinary torpedo boat and it is expected that the Silure will do as well after her crew becomes well drilled. The Triton and Espadon have maintained an average speed of 10 knots during a forty mile run on the surface, and this is much faster than any submarine boat has been able to go for a long distance. The submergible type is not just now much in favor, however, as all the new boats are of a modified Morse (true submarine) type.

SUBMARINE EXPERIMENTS AT CHERBOURG.—"A great submarine boat demonstration has taken place at Cherbourg. The Bouvines and Cassini bombarded the forts from the west, the Tréhouart from the east. As a defence against the first were the submarine Morse and submersible Narval; against the Tréhouart, the Triton and Espadon. The Francais was held in reserve outside the breakwater, equidistant from either submarine group. On the west, the Narval failed to reach the Bouvines, but the Morse torpedoed her at a hundred yards, firing a torpedo with a collapsible head. French accounts say that as, if charged, this torpedo—an 18-inch one—carries over 150 lb. of gun-cotton, the Bouvines would, in real war, have been "probably sunk." Undoubtedly, and—we fancy—also her antagonist, which certainly went too near. After torpedoing the Bouvines—which she did by periscope steering entirely—the Morse rose and was seen by the Cassini, which at once steamed away. In doing so she nearly ran down the Francais, submarine, which cut her off and torpedoed her. On the east, the submersible Triton got near the Tréhouart, but a fishing boat intervened and upset her course apparently, as she rose to the surface to take bearings. The Tréhouart steamed up firing, and was given to have sunk this boat. At the same time the Espadon, submarine, advanced and torpedoed the Tréhouart without being discovered. Both submarines—Morse and Francais—succeeded, all three submersibles failed. Hence an opinion that the former are far more efficient vessels for harbor defence."—*Engineer* (London), January 31, 1902.

SUBMARINE BOAT TRIALS AND EXPERIMENTS.—"The new submergible boats of the 'Narval' type are continuing their trials, both the 'Triton' and the 'Sirene' having given, on the whole, satisfactory results; the 'Sirene's' last trial was for 24 hours, four of which were spent under water; her time for actual submersion from the beginning of the plunge was five minutes, and her stability and habitability are reported to be good, but they are not considered by competent judges to be as good as the submarine boats proper, like the 'Morse,' 'Francais,' and 'Algérien,' which can be manœuvred with much more certainty. Their great—one may say fatal—defect is the slowness of their submergence. If they are ever sighted by an enemy's cruiser, battleship, or destroyer, their doom is sealed. Under the most favorable conditions it takes fifteen

minutes from the time they begin to fill their ballast tanks for submergence—and longer if attempting to go ahead. A destroyer can run 6 or 7 miles in fifteen minutes, and a cruiser or battleship at least 4 miles. The 'Narval' type could, therefore, never approach within striking distance of an enemy without reasonable certainty of being destroyed, unless they operate as submarines. The 'Espadon,' the latest to be completed here, made her trial plunge on the 18th ult. She took 8 minutes to sink to a depth of 26 feet, and she remained submerged for 2½ hours; on rising she came to the surface at once, where her full speed is 10 knots. The 'Silure,' the last of the four of this type, was launched on the 29th ult., and she is the eighth submarine now afloat at that port. She is of the modified 'Narval' type, and possesses the advantages of being able to recharge her own accumulators, whereas vessels of the 'Morse' type, such as the 'Francais' and 'Algérien,' have to recharge theirs at some electrical station. There are at present no more submergible boats under construction at this yard. It is stated that the new submarine boats already commenced, or to be commenced this year, will have a double motive power like the submergible boats; that is to say, a vapor of gas engine and electric accumulators. They will not be, however, submergible boats of the 'Narval' and 'Sirene' type, but true submarines in the proper sense of the word; only they will have a motor for propulsion when at the surface and for recharging the accumulators—the latter being used only when submerged. In a word, they will realize up to a certain point the autonomous type of submarine boat. They will have a radius of action a little more extended than that of the purely submarine boat, and will plunge more quickly than the 'Narval' and 'Sirene,' which are obliged to fill the ballast tanks between the hulls—a long operation as we know. The newer submarines, thanks to their small dimensions, will be easy to manœuvre. But one must not forget that, like all submarines, they are, above all, fair-weather weapons, and particularly weapons for use during daylight. At night, in a calm—or nearly calm—sea, they can still operate; but, unlike the ordinary torpedo-boat, they are not an arm whose most effective work is night attack. The submarine boat 'Morse' will very soon make a descent and remain submerged for 16 hours, in the course of which a tablet prepared by Dr. Gibrat will be tested. The tablet will be applied to the lips and nostrils in order to prevent the inhalation of toxic gases with which the air of submarine boats is charged. A submarine boat of a new type, designed by M. Romazotti, the designer of the 'Morse,' is to be built here. It will be an experimental boat, costing 499,400 francs (£19,976), and will differ notably from the other little vessels of this sort which are to be built."—*Journal of the Royal United Service Institution*, November, 1901.

GERMANY.

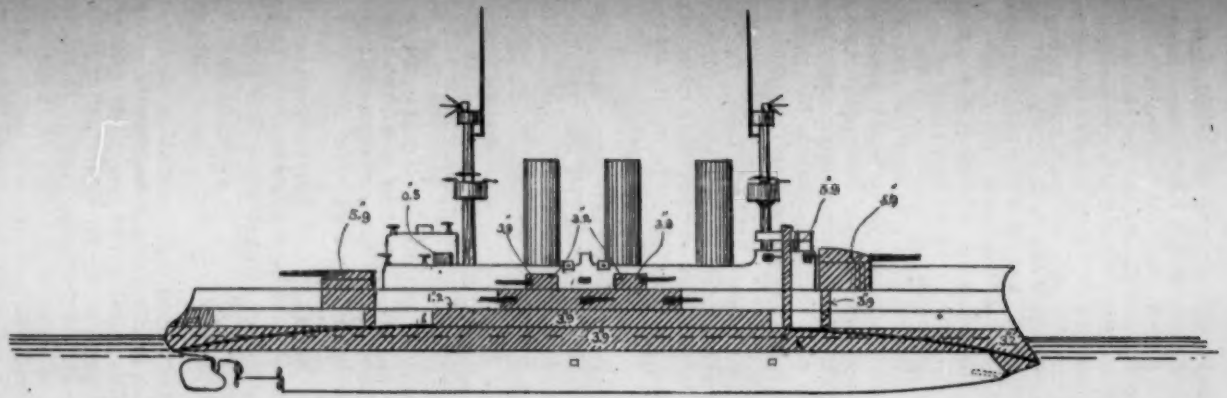
BUDGET AND PROGRAM FOR 1902.—The full text of the budget for 1902 has not yet been published. The total sum appropriated is 209,000,000 marks ($49,742,000; 1 mark = $0.238), of which the sum of 112,800,000 marks is devoted to new construction and armament. The usual allotments are made for vessels and works already in hand and the following provide for new construction to be commenced this year: 3,300,000 marks each as first payment on the new battleships K and L; 3,800,000 marks as first payment on a large armored cruiser to replace the Kaiser;

1,260,000 marks each as first payment on the new small cruisers K and L and on one to replace the Zieten; 2,400,000 as first payment on a new torpedo division; 800,000 marks as first payment for gunboat B; 1,125,000 marks each as first payment towards reconstruction of the ships of the Brandenburg class; 400,000 marks for a river gunboat in China; 800,000 for the transformation of the old cruiser Marie into a gunnery ship; and 1,000,000 marks for preparing the cruiser Nixe as a cadet schoolship and the Sophie as a schoolship for boys. During the year one of the new battleships will be commenced at Wilhelmshavn and the armored cruiser will be commenced at Kiel. The new construction thus provided for forms part of the general naval program; in addition to the gradual augmentation of the fleet in carrying out the program the government thinks of constructing two other battleships, five cruisers and six torpedo boats, and of requesting the approval of this plan by the Reichstag in a special legislative act.

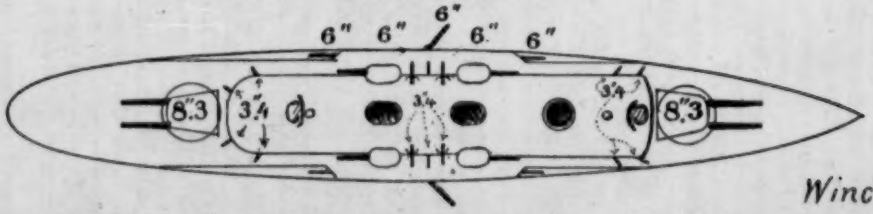
VESSELS BUILDING.

Name.	Displacement, tons.	Where building.	Remarks; date of launch, etc.
Battleships.			
Wittelsbach	11,900	Govt. Yd., Wilhelmshavn.	Lchd. July 3, '00; compl. '02.
Wettin	11,900	Schichau, Dantzic.	Lchd. June 6, '01; compl. '03.
Zahringen	11,900	Germania Yard, Kiel.	Lchd. June 12, '01; compl. '03.
Mecklenburg	11,900	Vulcan Works, Stettin.	Lchd. Nov. 9, '01; compl. '03.
Schwaben	11,900	Govt. Yd., Wilhelmshavn.	Lchd. Aug. 19, '01; compl. '03.
H	13,000	Germania Works, Kiel.	Laid down 1901.
I	13,000	Schichau, Dantzic.	Laid down 1901.
K	13,000	(Either K or L will be laid	
L	13,000	down at Wilhelmshavn.)	
Kaiser Karl der Grosse	11,130	Blohm & Voss, Hamburg.	Launched 1899; compl. 1902.
Kaiser Barbarossa	11,130	Schichau, Dantzic.	Nearly ready for service.
Armored Cruisers.			
Prinz Heinrich	8,868	Government Yard, Kiel.	Lchd. Mar., 1900; compl. 1902.
Prinz Adalbert	9,000	" " "	Lchd. June, 1901; compl. 1903.
Ersatz Konig Wilhelm	9,000	Blohm & Voss, Hamburg.	To be lchd. near end of 1902.
Ersatz Kaiser	9,000	Government Yard, Kiel.	Ordered.
Protected Cruisers.			
Thetis	2,645	Govt. Yard, Dantzic.	Practically ready for service
Ariadne	2,645	Weser Yard, Bremen.	" " "
Amazone	2,645	Germania Yard, Kiel.	Nearly ready for service.
Medusa	2,645	Weser Yard. Bremen.	Lchd. Dec. 5, '00; compl. '02.
G	2,645	Howaldt Co., Kiel.	Laid down 1901.
H	2,645	" " "	" " "
I	2,645	Weser Co., Bremen.	" " "
K	2,715		Not yet ordered.
L	2,715		" " "
Ersatz Zieten	2,715		" " "
Gunboats.			
Panther	899	Govt. Yard, Dantzic.	Lchd. April 1, '01; compl. '02.
B	?		Not yet ordered.
River gunboat	?		" " "
Torpedo Boats.			
S 102 to S 107 (6 boats).	350	Schichau, Dantzic.	All launched; compl. 1902.
G 108 to G 113 (6 boats).	350	Germania Yard, Kiel.	Some launched; compl. 1903.
S 114 to S 119 (6 boats).	350	Schichau, Dantzic.	Said to have been ordered.

PERSONNEL: NUMBERS.—According to the *Army and Navy Gazette* and other service papers the executive officers of the German navy on



Prinz Adalbert.



Winchell.

NOTE.—The Prinz Adalbert is fully described in PROCEEDINGS No. 99, page 600.

January 1, 1902, were: 3 admirals, 6 vice-admirals, 16 rear-admirals, 52 captains, 20 frigate-captains, 107 corvette captains, 206 captain-lieutenants first class, 323 captain-lieutenants second class, 203 lieutenants zur see, 339 fähnrich (ensign) zur see, 209 cadets. Total executive officers, 1484; total of other corps, 539. (See Professional Notes in PROCEEDINGS No. 99, page 597.) The law of 1900 provides for an increase of 1212 officers in 20 years, and as the present arrangements are inadequate to supply the necessary officers arrangements are being made to augment the number of cadets at the Naval Academy at Kiel and on board the training ships. Though the budget gives no indication of the fact, the German newspapers say that a large training ship for cadets is to be built; it will accommodate 200 and will be fitted with study rooms, a museum, a gymnasium, a library, and a large saloon.

BATTLESHIPS H, I, K, L: SUPPLEMENTAL DETAILS.—A partial description of these ships is given in PROCEEDINGS No. 100, page 761, but further details have been published. The protection is practically identical with that of the Wittelsbach class (see PROCEEDINGS No. 97, page 160; battleship G); the designed I. H. P. of the machinery is 16,000 but the speed remains the same, about 19 knots, the increase of horsepower being required by the enlarged dimensions of the new ships. The coal supply at load draft is 700 tons and the total bunker capacity, 1800 tons. The dimensions are: Length, 397 feet; beam, 75.46 feet; mean draft, 24.9 feet; displacement, 13,000 tons. The details given in No. 100 are, so far as known, correctly stated.

ERSATZ KONIG WILHELM, ERSATZ KAISER, AND PRINZ ADALBERT: REMARKS.—The armored cruisers Ersatz Konig Wilhelm and Ersatz Kaiser are sister ships in all respects to the Prinz Adalbert, fully described in PROCEEDINGS No. 99, page 600, but the beam of the Adalbert is erroneously given and should be 65.6 feet.

PROTECTED CRUISERS K, L, AND ERSATZ ZIETEN: REMARKS.—It is reported that these cruisers will differ from their predecessors of the Gazelle class, and that their dimensions will be: Length, 360 feet; beam, 40.3 feet; displacement, 2715 tons. The speed is to be 24 knots and the complement 260 men. The armament has not been decided upon but it will be more powerful than that of the Gazelle type.

ERSATZ ALEXANDRINE, ERSATZ BLITZ, ERSATZ PFIEL: REMARKS.—It is reported that these cruisers are to be laid down this year but no mention is made of them in the budget extracts which have appeared. It is said they will have the dimensions given in the preceding paragraph for protected cruisers K, L, and Ersatz Zieten.

WORTH: RECONSTRUCTION.—The first of the Brandenburg class to be reconstructed is the Worth, which will be taken in hand at the government yard at Wilhelmshavn. The midship turret with its guns and fittings will be removed and the upper deck carried aft, joining that of the superstructure which is between the two after turrets. In the new superstructure thus formed will be mounted a battery of 15-centimeter guns protected by armor. The secondary battery will also be greatly changed. The over-water torpedo tubes will be removed and replaced by submerged tubes. The ventilation, which is very bad below the

protective deck, will be improved; all wood work will be removed; and some changes made in the interior compartment system.

KRONPRINZ: STRUCK FROM LIST.—The name of the old central battery battleship Kronprinz (5568 tons, launched in 1867) has been struck from the list of the navy.

TORPEDO BOATS S103, S104, S106: TRIALS.—These boats, built by Herr F. Schichau at Elbing, are now all practically completed. On the 6-hour full-power trials the speeds developed were: No. 103, 27.5 knots; No. 104, 28.95 knots; No. 106, 28 knots on the preliminary trial.

SUBMARINE BOAT: UNSATISFACTORY TRIALS.—Reports from Berlin state that the Admiralty has postponed indefinitely the question of the adoption of a type of submarine boat for the German navy. The trials of the Howaldt boat are far from satisfactory and further investigation of the submarine question is to be made.

GREAT BRITAIN.

BUDGET AND PROGRAM FOR 1902-03.—The following is an abstract of the Estimates as submitted to Parliament and they are likely, as usual, to be approved with very few and unimportant changes:

ABSTRACT OF THE ESTIMATES.

VOTES.	NET ESTIMATES. 1902-1903	1901-1902
I.—NUMBERS.		
A. Total No. of officers, seamen, boys, Coast Guard and Royal Marines	122,500	118,625
II.—EFFECTIVE SERVICES.	£	£
1. Wages, &c. of officers, seamen and boys, Coast Guard and Royal Marines	5,962,000	5,760,000
2. Victualling and clothing for Navy	2,023,500	1,892,300
3. Medical Establishments and Services	246,500	219,000
4. Martial Law	17,700	16,200
5. Educational Services	101,700	100,600
6. Scientific Services	65,600	65,800
7. Royal Naval Reserves	286,900	292,100
8. Shipbuilding, Repairs, Maintenance, &c.:—		
Sect. I.—Personnel	2,661,500	2,684,000
II.—Material	4,812,700	5,306,500
III.—Contract Work	7,665,800	6,685,500
9. Naval Armaments	3,356,400	3,919,700
10. Works, Buildings and Repairs at Home and Abroad	1,100,000	1,023,100
11. Miscellaneous Effective Services	368,000	359,500
12. Admiralty Office	294,300	279,000
Total Effective Services	28,962,600	28,603,900
III. NON-EFFECTIVE SERVICES.		
13. Half Pay, Reserved, and Retired Pay	782,100	790,900
14. Naval and Marine Pensions, Gratuities, and Compassionate Allowances	1,160,700	1,140,100
15. Civil Pensions and Gratuities	350,100	340,600
Total Non-Effective Services	2,292,900	2,271,000
Grand Total	31,255,500	30,875,500
Net Increase	£380,000	

The personnel is to be increased by 3875. The various reports in regard to the numbers of officers in each grade are not in accord; if these can be ascertained they will be published in No. 102. Of the new building program, a battleship (No. 1) is to be laid down at Portsmouth and an armored cruiser (No. 1) at Pembroke. There will be given out to contract one battleship (No. 2), one armored cruiser (No. 2), two protected cruisers (Nos. 1 and 2), four scouts, nine torpedo-boat destroyers, four torpedo boats, and four submarine boats. The designs of all these vessels are yet to be prepared and few if any are likely to be laid down before January 1, 1903, so they are not included in the table of vessels building.

VESSELS BUILDING.

Name.	Displacement.	Where building.	Remarks, date of launch, completion, etc.
Battleships.			
Commonwealth	16,500	To be built in private yd.	Not yet ordered.
Dominion	16,500	" " "	" "
King Edward VII	16,500	Govt. Yard, Devonport.	Keel to be laid in March.
Queen	15,000	" " "	To be lchd. Mar. 8, compl. '03.
Prince of Wales	15,000	" " Chatham.	To be lchd. Mar. 25, compl. '03
Albemarle	14,000	" " "	Lchd. Mar. 5, '01; compl. '03.
Cornwallis	14,000	Thames Co., Blackwall.	Lchd. July 17, '01; compl. '03.
Duncan	14,000	" " "	Lchd. Mar. 21, '01; compl. '03.
Exmouth	14,000	Laird Bros., Birkenhead.	Lchd. Aug. 31, '01; compl. '03.
Montagu	14,000	Govt. Yard, Devonport.	Lchd. Mar. 5, '01; compl. '03.
Russell	14,000	Palmer Co., Jarrow.	Lchd. Feb. 19, '01; compl. '03.
Bulwark	15,000	Govt. Yard, Devonport.	Practically complete.
Venerable	15,000	" " Chatham.	Trials about Apl. 1; compl. '02
London	15,000	" " Portsmouth.	Trials in progress; compl. '03.
Armored Cruisers.			
Drake	14,100	Govt. Yard, Pembroke.	Lchd. Mar. 5, '01; compl. '02.
King Alfred	14,100	Vickers, Barrow.	Lchd. Oct. 28, '01; compl. '03.
Leviathan	14,100	J. Brown & Co., Clydebk.	Lchd. July 3, '01; compl. '03.
Good Hope	14,100	Compl'g at Portsm'th Yd.	Lchd. Feb. 21, '01; compl. '02.
Hampshire	10,200	To be built in private yd.	Not yet ordered.
Devonshire	10,200	Govt. Yard, Chatham.	Ordered.
Roxburgh	10,200	To be built in private yd.	Not yet ordered.
Antrim	10,200	" " "	" "
Argyll	10,200	" " "	" "
Carnarvon	10,200	" " "	" "
Essex	9,800	Govt. Yard, Pembroke.	Lchd. Aug. 29, 01; compl. '02.
Kent	9,800	" " Portsmouth.	Lchd. Mar. 6, '01; compl. '02.
Monmouth	9,800	Lond. & Glasg. Co., Glasg.	Lchd. Nov. 13, 01; compl. '03.
Bedford	9,800	Fairfield Co., Govan.	Lchd. Aug. 31, '01; compl. '03.
Cornwall	9,800	Govt. Yard, Pembroke.	Ord'd Nov. '00; not yet lchd.
Suffolk	9,800	" " Portsmouth.	" " "
Berwick	9,800	Beardmore (ex-Napier), Glasgow.	" " "
Cumberland	9,800	Lond. & Glasg. Co., Glasg.	" " "
Lancaster	9,800	Armstrong, Elswick.	" " "
Donegal	9,800	Fairfield Co., Govan.	" " "
Hogue	12,000	Vickers, Barrow.	Trials finished; compl. 1902.
Sutlej	12,000	Completing at Govt. Yd., Chatham.	Practically ready for service
Euryalus	12,000	Vickers, Barrow.	Delayed by accdt.; compl. '03.
Bacchante	12,000	Completing at Govt. Yd., Chatham.	Nearly ready; trials finished.

VESSELS BUILDING—*Continued.*

Name.	Displacement.	Where building.	Remarks, date of launch, completion, etc.
Protected Cruisers.			
Spartiate	11,000	Govt. Yard, Portsmouth.	Alterations in progress.
Challenger	5,880	" " Chatham.	To be lchd. summer of 1902.
Encounter	5,880	" " Devonport.	To be launched 1902.
Turquoise	3,000	Beardmore, Glasgow.	Ordered.
Amethyst	3,000	" "	"
Gunboats.			
Odin	1,096	Govt. Yard, Sheerness.	Lchd. Nov. 30,'01; compl. '02.
Merlin	1,096	" " "	" " "
Espiegle	1,075	" " "	Practically complete.
Fantome	1,075	" " "	Trials about July 1; compl. '02
Cadmus		" " "	Ordered.
Clio		" " "	"
Torpedo Boat Destroyers.			
Derwent	?		Not yet ordered.
Eden	?		" "
Erne	?		" "
Exe	?		" "
Kittrick	?		" "
Foyle	?		" "
Ilchen	?		" "
Ribble	?		" "
Teviot	?		" "
Usk	?		" "
Arab	320	J. Brown & Co., Clydebk.	Under trial for some months
Ostrich	355	Fairfield Co., Govan.	Under trial for some months
Express	430	Laird Bros., Birkenhead.	Under trial for several yrs.
Success	360	Doxford, Sunderland.	Lchd. 1901; not yet had trials
Torpedo Boats.			
(1)	185	Thornycroft, Chiswick.	Ordered.
(2)	185	" "	"
(3)	185	" "	"
(4)	185	" "	"
Submarine Boats.			
(1)	120	Vickers, Barrow.	Launched; compl. 1902.
(2)	120	" "	"
(3)	120	" "	"
(4)	120	" "	"
(5)	120	" "	"
(6)	?	" "	Ordered.

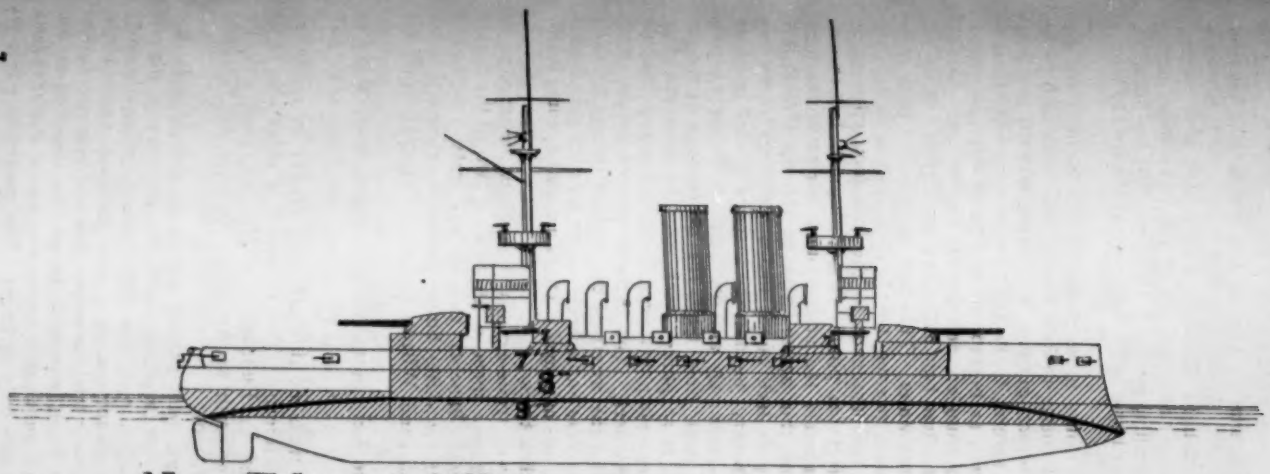
PERSONNEL: CARE OF ELECTRIC AND HYDRAULIC MACHINERY TRANSFERRED TO EXECUTIVE OFFICERS.—"The Admiralty have quite recently decided—in connection with the care and maintenance of certain of the more important portions of the machinery supplied to British men-of-war—to make a change which may possibly have far-reaching results. The engineer officers of a ship have hitherto been required to undertake the charge of and to be responsible for the maintenance in a state of efficient working order, of the following among other parts of the machinery: All steam and hydraulic pumping and other engines for loading and working the guns, for supplying ammunition, and for turning turret barbette platforms, and other forms of gun mountings; all Whitehead and other torpedoes, and submerged tubes and gear; and all electric light engines and dynamos. It has also been a special in-

struction to the captains of ships in regard to the torpedoes, that 'the dynamos and engines for driving them are in charge of the engineer officer, who is responsible for their mechanical and electrical efficiency.' The result of this arrangement, by which one man was responsible for the effective working of a machine and another for its efficient use, was not always happy, and somewhat conducive to friction. Moreover, it had a distant bearing on the burning question of the position of the engineer officers of the Navy, and has been one of the principal arguments used in the rather heated discussion which has arisen out of that matter. By the new regulations all this is to be altered. The gunnery lieutenant is in future to take charge of all the hydraulic machinery which is in any way connected with the gun mountings, while the torpedo lieutenant is to be responsible for the dynamos, motors, torpedoes, and all the fittings which have to do with the torpedo armament. All these matters have thus been removed from the care and control of the engineer officer, who will now be simply required to provide steam to work the dynamos and hydraulic engines."—*Engineering*, January 24, 1902.

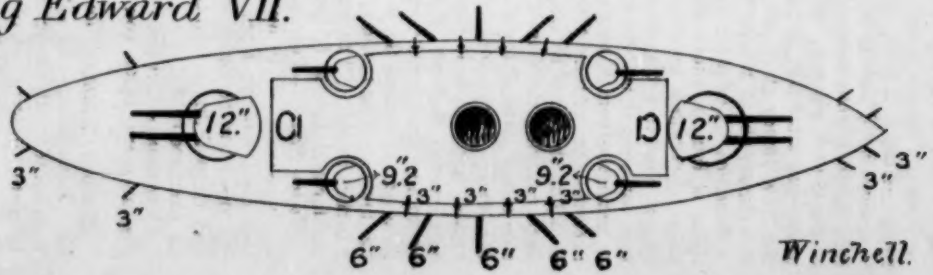
ENGINEERING COLLEGE AT KEYHAM: STUDENTS TO ENTER THIS YEAR.—"The officials at the Royal Naval Engineering College, Keyham, have been informed that the Admiralty intend entering forty-six engineer students in July next. Of this number forty-two will be entered by open competition, two will be nominated colonial candidates, and two nominated service candidates. In the event of the colonial and nominated service candidates failing to qualify at the examination, their places will be filled by candidates from the open competition list. We understand that two studentships in naval construction will be offered to the most successful candidates on the open competition list."—*Engineer* (London), December 27, 1901.

VESSELS OF THE BUILDING PROGRAM OF 1901-02: REMARKS.—The vessels of the program for 1901-02 are, with one or two exceptions, not yet (February 15) commenced and many are not yet ordered, but it is expected that they will be ordered or given out to contract before April 1. Proposals for the ten new torpedo-boat destroyers have been asked. While the contractors will be given a free hand in regard to designs the requirements are likely to result in vessels of about 500 tons, much stronger and more seaworthy than the previously-built boats and of less speed—26 knots on a long trial in seagoing trim being about the requirements. The four new torpedo boats ordered from Messrs. J. I. Thornycroft & Company of Chiswick are to be exactly like Nos. 107 and 108, so that the parts of the machinery will be interchangeable. The keel of the battleship King Edward VIII will be laid at Devonport Yard in March on the slip from which the Queen is to be launched; the other two battleships are to be built in private yards but the contracts have not yet been awarded. The new armored cruisers will resemble those of the "County" class, but are slightly larger (10 feet longer and 1 foot wider); they will have about the same I. H. P. and are designed to have the same speed. The third class cruisers will be of about 3000 tons.

KING EDWARD VII: DESCRIPTION.—The descriptions of this vessel that have so far appeared are fragmentary and incomplete: and they may be incorrect—if so, the correct particulars will be given as they transpire.



King Edward VII.



Winchell.

The general appearance is similar to that of the Formidable but there are certain marked differences. There are two masts, each carrying a single fighting top, a search-light platform, and a high pole topmast. The smokepipes, two in number as usual, are on the fore-and-aft midship line. There is no superstructure, properly so called, but the main deck between the turrets is enclosed by a light rail rising at the ends to support bridge decks and bridges.

Armament.—Four 12-inch guns in pairs in turrets forward and aft; four 9.2-inch guns mounted singly in four turrets, one over each corner of the 6-inch battery; ten 6-inch guns in broadside, forward pair firing ahead and after pair firing astern; these guns are mounted like those in the New Jersey class and not, as heretofore in British ships, in separate casemates; about twenty 12-pounders and several 3-pounders.

Protection.—Complete water-line belt extending from stem to stern and rising a foot or more above water. This belt is 9 inches thick amidships, decreasing in thickness beyond the 12-inch turrets forward and aft; at the stem the main belt descends to the fore foot, covering the ram for several feet back from its point. Above the main belt the side is armored from a point abreast the after 12-inch turret to the stem; between the 12-inch turrets this armor rises to the main deck; it is 8 inches thick up to the gun deck and 7 inches thick up to the main deck covering the 6-inch battery; beyond the forward 12-inch turret the side armor rises to the gun deck only and decreases in thickness towards the stem. The protective deck rises from the lower edge of the side armor, and below it there is a splinter deck. At the after end of the side armor there is a thwartship armored bulkhead rising from the protective deck to the main deck. The barbette towers for the 12-inch guns are 12 inches thick and the fronts of the 12-inch turrets are 10 (or 12) inches. The barbette towers and turrets of the 9.2-inch guns are 6 to 7 inches thick. All turrets are balanced. There are two conning towers, the forward one 12 (?) inches thick.

Motive Power.—Twin-screw, triple-expansion engines, designed to develop 18,000 I. H. P. and give a speed of 18 knots. Two of the ships of this class will be fitted with Babcock and Wilcox water-tube boilers; the third will be fitted with two-fifths boiler power in cylindrical boilers and three-fifths in Babcock and Wilcox boilers. The coal supply will be over 2000 tons.

Dimensions.—Length, 420 feet; beam, 78 feet; mean draft, 26.75 feet; displacement, 16,500 tons.

HOGUE: TRIALS.—The trials of this armored cruiser of 12,000 tons have been completed satisfactorily. The Hogue is a sister ship to the Bacchante, fully described in PROCEEDINGS No. 97, page 168. The following description of the trials of the Hogue is from the *Engineering* (London) of December 27, 1901:

"The trials of the Hogue were carried out in an exceptionally short period, not the slightest hitch interfering with the programme originally drawn up by the Admiralty, and she experienced sufficiently rough weather to establish her steadiness as a gun platform under adverse conditions. On the full-power trial the mean speed of four runs between the Lizard and Dodmans Point was 22.06 knots, the speed on the four runs being respectively 21.8 knots, 22.2 knots, 21.5 knots, and 22.75 knots, while the designed speed was only 21 knots. The maximum power was

22,154 indicated horse-power, and the mean on the four runs 21,432, while the contract called for 21,000 indicated horse-power. The results, therefore, are eminently satisfactory. On the trial of 30 hours' duration at what is termed the continuous steaming power—that at which the vessel must go as long as her coal lasts—the speed was 20.15 knots for 16,456 indicated horse-power; while at one-fifth power—the ordinary cruising condition—the speed was 13 knots for 4738 indicated horse-power. We tabulate the full results of all three trials:

TRIALS OF H. M. S. HOGUE.

	30 hours coal consumption, Dec. 11 and 12.		30 hours coal consumption, Dec. 13 and 14.		8 hours' full power, Dec. 17.	
	Starboard.	Port.	Starboard.	Port.	Starboard.	Port.
Mean steam in boilers	190	190	..	..	285	285
" " at engines	179	179	220	226	221	221
Mean air pressure in stokeholds	..	..	..	..	.4	.4
Mean cut-off in high-pressure cylinder, per cent.	30	30	..	..	78.7	78.7
Mean vacuum	27.3	26.8	25.6	25.5	25.1	25
" revolutions	74.8	74.6	113.1	111.6	123.6	121.4
Mean Pressure in Cylinders: High	41.8	44.5	102.5	104.3	116.6	112.1
Intermediate	15	15	34.7	34.8	38.4	39.7
Low forward	6.2	6.5	13.3	13.8	18.6	18.8
" aft	6	6.2	13.5	15.3	19.3	20.3
I. H. P.: High	773	820	2861	2874	3,405	3,358
Intermediate	748	745	2604	2580	3,144	3,198
Low forward	412	428	1326	1961	2,028	2,016
" aft	398	414	1348	1502	2,109	2,174
Total I. H. P	2331	2407	8139	8317	10,686	10,746
Gross total I. H. P.	4738		16,456		21,432	
Mean speed	13 knots		20.15 knots		22.06 knots	
Coal	2.09 lb.		2.05 lb.		2.06 lb.	

The trials, it should be stated, were carried out with a close approximation to service conditions. The coal was not hand-picked, nor were the stokers specially-trained men. The Hogue is an armored cruiser of 12,000 tons displacement at 26 ft. 3 in. draft, her length being 440 ft. and her beam 69 ft. 6 in. She has 6-in. armor on her broadside, and her armament includes two 9.2-in. breechloading guns, with twelve 6-in. quick-firers, and 17 smaller weapons. The Vickers mountings for 9.2-in. guns have in their trials enabled five rounds (380 lb.) per minute to be fired. The machinery of the Hogue is of the twin-screw triple-expansion type, each set having four cylinders, respectively 36 in., 59 in., and two at 68 in. in diameter, all having a stroke of 48 in. The 30 water-tube boilers have an aggregate grate area of 1650 square feet, and a heating surface of 51,500 square feet, and on trial the power was equal to practically 12 indicated horsepower per ton of machinery."

BACCHANTE: TRIALS.—The trials of this armored cruiser were completed December 7, 1901, with the following results:

Character of trial	1-5 power.	4-5 power.	Full power.
Duration of trial	30 hours.	30 hours.	8 hours.
Date of trial	Nov. 26-27.	Nov. 28-29.	Dec. 7.
I. H. P.	4624	16,445	21,520
Revolutions	75.2	112.7	120.1
Speed, knots	14	20.6	21.75
Coal per I. H. P., lbs.	1.8	1.75	1.7

The Bacchante is fully described in PROCEEDINGS No. 97, page 168.

SPARTIATE: UNSATISFACTORY TRIALS, REMARKS.—This unfortunate cruiser (11,000 tons) was commenced in 1897, launched in 1898 and has since been subjected to a long list of accidents. While her sister ships are completing their first three years of commission she has again failed on trial, and it appears that her condenser tubes must all be removed and replaced; during her last run many of them broke right across. It will therefore be some months before she can resume her trials.

MERLIN, ODIN: FLOATED OUT, DESCRIPTION.—These two gunboats were built side by side in drydock at the Sheerness yard and floated out November 30, 1901. The keels were laid on the eleventh of February preceding. They are similar in general type to the Vestal and Rinaldo, are built for foreign service, and the hull is of steel, sheathed with wood and coppered. They are of the well-deck type with raised poop and forecastle, have a single smoke-pipe, twin-screws, and a barquentine rig. The complement is 113. The principal details are:

Armament.—Six 4-inch guns, one each side on the forecastle and one each side on the main deck amidships. The secondary battery consists of four 3-pounders and three Maxim machine guns of .303-inch caliber.

Motive Power.—Twin-screw triple-expansion engines, designed to develop 1400 I. H. P. and give a speed of 13.25 knots. The Odin will have Babcock and Wilcox boilers and her machinery has been built by the Wallsend Slipway and Engineering Company; the Merlin will have the Belleville boilers which were built for the Fantome, and her engines have been constructed at the Sheerness yard. The Merlin was to have had Niclausse boilers, but as they were completed some months before she was ready for them they were placed on the Fantome which has recently completed her trials.

Dimensions.—Length, 185 feet; beam, 33.4 feet; draft forward, 11 feet; draft aft, 11.5 feet; displacement at this immersion, 1096 tons.

RINALDO, VESTAL: TRIALS, DESCRIPTION.—These two gunboats of the Condor type have completed their trials. The Rinaldo was built at the yard of Messrs. Laird Brothers, Birkenhead, where she was launched May 29, 1900; the Vestal was built at the government yard, Sheerness, and launched February 10, 1900. These gunboats are designed for foreign service and have steel hulls sheathed with wood and coppered, and have a light barque rig, one smoke-pipe, and a single screw. They are well-decked with a raised poop and forecastle. The complement of officers and men is 130. The principal details are:

Armament.—Six 4-inch guns: one each side on the poop and forecastle and one each side in the waist; all are protected by shields. The secondary battery consists of four 3-pounders and two Maxim machine guns of musket caliber.

Motive Power.—Single-screw, triple-expansion engines designed to develop 1400 I. H. P. and give a speed of 13.25 knots. The boilers are of the Belleville water-tube type. Coal capacity, 130 tons.

Dimensions.—Length, 180 feet; beam, 33 feet; mean draft, 11.5 feet; displacement, 980 tons.

The commission trials of both vessels took place in December with the following results:

	Vestal.	Rinaldo.
Steam pressure at boilers	243	234
Steam pressure at engines	241	216
I. H. P., total	1438	1424
Revolutions	198	199.2
Speed, knots	12.4	13.4

The speed of the Vestal is given in several publications as 12.4 knots but this is, nevertheless, probably an error. It is hard to see how greater I. H. P. and almost the same number of revolutions should give a whole knot less speed unless the vessel had different screws from the other or was badly trimmed.

Fantome: Trials.—The gunboat Fantome, a sister ship to the Espiegle (fully described in Proceedings No. 97, page 169), has completed her trials with the following results:

Character of trial	1-5 power.	3-4 power.	Full power.
Duration "	30 hours.	30 hours.	8 hours.
I. H. P.	339	1020	1453
Revolutions	126	177	200
Speed, knots	9.25	12.5	13.63
Coal per I. H. P., lbs.	1.7	1.53	1.53

The Fantome differs from the Espiegle in having Niclausse instead of Babcock and Wilcox boilers.

Centurion: Alterations.—The battleship Centurion, 10,500 tons, is to be extensively repaired at Portsmouth dockyard. The ten 4.7-inch guns which she now carries are to be replaced by ten 6-inch of the latest model with Vickers breech mechanism. The six guns on the upper deck, which now have light shields only, will be fitted with armor protection.

Majestic: New Guns.—The battleship Majestic is under repair at Portsmouth dockyard. The loading and training gear of her turrets will be improved and her 6-inch guns, which have old type breech mechanism requiring three movements to open, will be replaced by others having breech mechanism of the latest type, while her Maxim machine guns of .45-inch caliber will be replaced by new guns of caliber .303-inch.

Polyphemus: Converted into a Tender.—The old torpedo ram Polyphemus (2640 tons, launched at Chatham in 1881) is to be dismantled and converted into a tender to the torpedo school ship Vernon.

Terrible: Speed Trial at Sea.—The following details of the recent speed trials of the protected cruiser Terrible, 14,200 tons, are derived from *Engineering* (London). The trials took place on passage from Yokohama to Wei-hei-wei.

Duration of trial		4 hours.	20 hours.
Draught of water...	Forward	27 feet, 5 inches.	
	Aft	29 " 10 "	
Load on safety valves		260 lbs.	
Pressure in boilers (mean)		230 lbs.	230 lbs.
" at engines (mean)		200 "	200 "
Vacuum (mean)		25 inches.	25 inches.

Cut-off in high-pressure cylinders, p. c.	70	
Revolutions per minute	106.5	94
Indicated horsepower	24,008	15,129
Speed of vessel	21 knots.	18.5 knots.
Force of wind	2 "	2 to 4 "
State of sea	Smooth.	
" " ship's bottom	Slightly foul.	
Coal consumption per hour per indicated horsepower, main engines	2.19 lbs.	1.9 lbs.
Coal consumption per hour per indicated horsepower, all purposes	2.3 "	2.16 "

TEMERAIRE, IRON DUKE, INVINCIBLE, NEPTUNE, ACHILLES, GLATTON, CYCLOPS, HECATE, GORGON: CONDEMNED AND TO BE STRUCK FROM LIST OF FLEET.—These vessels have all been condemned and their names will be struck from the list of the Fleet. The first five are old type battleships. The Temeraire has a mean load displacement of 8540 tons; the Iron Duke and Invincible, 6010 tons; the Neptune, 9310 tons; and the Achilles, 9820 tons. The Temeraire was recently stripped for reconstruction but the plan was abandoned. The Achilles, which was extensively repaired some years ago, and the Invincible have been on the non-effective list for a year or more. The Glatton, 4910 tons, and Cyclops, Gorgon and Hecate of 3560 tons, are old monitors, built in 1871.

RACEHORSE: TRIAL.—The torpedo-boat destroyer Racehorse completed satisfactory trials on December 12, with the following results: Speed for three hours' run 30.345 knots; mean of six runs over the measured mile course, 30.354 knots. The Racehorse has a mean load displacement of 316 tons; she was built by Messrs. Hawthorn, Leslie & Company, Hebburn-on-Tyne, and was launched November 8, 1900. During the summer of 1901 she attempted to go through her trials but was unsuccessful. The details of the Racehorse and of her sister boats, the Greyhound and Roebuck, are given in PROCEEDINGS No. 97, page 170.

BRITISH TORPEDO BOAT DESTROYERS: DIFFICULTIES WITH MACHINERY, UNSATISFACTORY TRIALS, DEFICIENCIES IN SPEED, ETC.—"A Parliamentary return recently issued gives the names of the various torpedo-boat destroyers built for the Admiralty, the dates on which they were ordered, and of whom, the dates when they were launched, the number of official trails to which they were subjected, and the dates when they were accepted by the Admiralty, or, in the case of unfinished boats, the expected date of delivery; also the number of preliminary trials of boats of 30 knots or over, and particulars of typical cases where those trials have been exceptional in number and have extended over considerable periods.

"The return includes the names of 113 boats, of which 19 were built by Messrs. Laird Brothers, of Birkenhead; 16 by Messrs. Thornycroft, of Chiswick; 16 by the Palmer's Company, of Jarrow; 12 by Thomson's, of Glasgow; the Clydebank Company, or J. Brown & Co., Clydebank; 9 by Messrs. Hawthorn, of Newcastle-on-Tyne; 9 by the Fairfield Company, of Glasgow; 8 by the Naval Construction and Armaments Company, of Barrow, or Messrs. Vickers & Co., of Barrow; 6 by Messrs. Doxford & Sons, of Sunderland; 5 by Messrs. Yarrow, of Poplar; 4 by

Earle's Company, of Hull; 3 by Messrs. Armstrong & Co., of Newcastle-on-Tyne; 3 by Messrs. J. S. White & Co., of Cowes; 2 by Messrs. Hanna, Donald & Wilson, of Paisley; and 1 by the Thames Ironworks Company, Blackwall.

"Some of the trials were remarkably protracted. Those of the Conflict, built by J. S. White & Co., Cowes, lasted from the 16th August, 1895, until 9th June, 1898; those of the Teazer, by the same firm, from 3rd January, 1896, to 22nd March, 1898; those of the Wizard, by the same firm, from 19th May, 1897, to 5th May, 1898. In each of these cases the delay was principally due to 'alterations to obtain speed.' Those of the Fervent lasted from 23rd August, 1895, to 4th August, 1899, and those of the Zephyr from 13th March, 1896, to September, 1900. In each case delay occurred through the substitution of water-tube boilers for locomotive boilers during the trials. The builders were Hanna, Donald & Wilson, Paisley. The trials of the Zephyr, by the Thames Ironworks Company, were protracted from 16th December, 1895, to March, 1897, by the necessity of renewing the boiler tubes. The trials of the Otter (Vickers, Sons & Maxim) lasted two years and a quarter through 'alterations to propellers to obtain speed,' and fracture of both crank shafts. The Brazen (Clydebank Company, Glasgow) was three years and a half under trials, owing to her inability to obtain speed, and she was finally accepted at 29¼ knots. The Express, tendered by Laird Brothers, Birkenhead, for 33 knots, had made 27 preliminary and 10 official trials between 20th October, 1898, and the date of the return (17th August last), but had been unable to realize the speed. The Albatross (Thornycroft) was 18 months under trial, and was then accepted half a knot under the specified speed. A number of shorter trials, yet extending to the best part of a year, were spun out by the difficulty of attaining the contract speed, and in several cases the vessels were finally accepted at a less speed. The ill-fated Viper underwent two official and three preliminary trials, and the Cobra two official trials only, but in neither case are any notes given of their performances. Of the later boats, in addition to the Cobra, the Petrel, Kangaroo (Palmer's Company), Thorn, Tiger, and Vigilant (J. Brown & Co., Clydebank) were purchased while building.

"The Parliamentary paper in question is calculated to convey a somewhat erroneous idea to the lay mind. The paper throws, perhaps, undue emphasis on the fact that the great majority of the 30-knot destroyers were unable to attain the speed for which they were designed, and some of them had to be accepted as boats of less speed than 30 knots. The fact is likely to be overlooked that the Admiralty, in giving out contracts for boats of this class, make certain stipulations and then leave the designs entirely to the judgment of the contractors. If, then, the boat fails to attain her speed, it is not through any miscalculation or error of judgment on the part of Admiralty officials, but to the inexperience of the contractors who design and build the boats. There is nothing startling in the disclosure that a 30-knot boat never reaches that speed after she is in commission, and the causes are so well known that it is hardly necessary to point out that when on trial a destroyer is at least 100 tons lighter than when she goes to sea under the pennant. On the whole, the return is interesting, though it need not be alarming."—*Journal of the Royal United Service Institution*, December.

NEW TORPEDO BOATS: REMARKS.—Reference to these boats has already been made on a preceding page under the head of "Vessels of the Building Program of 1901-02." They will be similar to Nos. 107 and 108 in all respects, so that the various fittings and parts will be interchangeable.

TORPEDO BOAT NO. 108: TRIAL.—This boat, which failed on her first trial (see No. 100, page 768), completed satisfactory trials November 18. On November 12, during the three-hour run, the mean I. H. P. was 2876; revolutions, 385.5; speed, 25.36 knots. On November 18, the results were 25.4 knots on the three-hour run and 25.3 knots on the measured mile; the boiler pressure was 219 pounds per square inch and the coal consumption 2 pounds per I. H. P. per hour. The dimensions of No. 108 are given in PROCEEDINGS No. 97 (see "New Torpedo Boats Ordered," page 170).

VELOX, NEW TURBINE TORPEDO-BOAT DESTROYER.—"It seems highly probable that an opportunity will occur sooner than was expected for replacing the Viper and the Cobra. A torpedo destroyer designed for steam turbine machinery was launched from the Hebburn yard of Messrs. Hawthorn, Leslie and Co., on Tuesday, February 11, and has been named the Velox. The vessel is 210 feet long, 21 feet wide, and 12 feet 6 inches moulded depth. She is not, therefore, so long as the Cobra or the Albatross, but of about the same dimensions as the Viper. The propelling machinery will consist of two independent sets of Parson's marine turbine engines; one high pressure engine, and one low pressure engine being on each side of the vessel. This gives four turbines, each of which has its own line of shafting, and as each shaft carries two propellers there are eight propellers in all. A set of ordinary reciprocating engines of the triple compound type are also fitted as a new feature, but these engines are only for use at cruising speeds when low power only is needed. This departure is particularly interesting as indicating what may very possibly happen in the near future in regard both to boilers and to engines. The water-tube boiler is essentially a boiler to raise steam with the utmost speed. The turbine machinery is only useful in its economical aspect when used at high rates of speed. May we not expect to see, therefore, the cylindrical and the water-tube boilers combined in the same cruiser with reciprocating and turbine engines? For harbor and ordinary use the Scotch boiler would be sufficient, but if it became necessary to raise speed in a hurry or for a spurt the water-tube type would come into play. Again, when running at ordinary speeds what we may call the old-fashioned engines would be utilized, but for high speed the turbine. The result would probably combine many advantages."—*Army and Navy Gazette*, February 15, 1902.

NEW TURBINE TORPEDO-BOAT DESTROYER: ORDERED.—According to statements appearing in *Le Yacht*, the *Engineer*, and other European papers, the Admiralty has ordered another turbine-driven torpedo-boat destroyer. According to *Le Yacht* it will embody the results of the experience with the Cobra and Viper and will be more economical in the use of fuel.

SUBMARINE BOAT OF NEW TYPE: ORDERED.—A new type of submarine boat has been ordered from Vickers, Son and Maxim, the owners of the

right to build Holland boats in England. This new boat, which is the sixth they have under construction, is very much larger than her predecessors, having a length of 100 feet—37 feet greater than that of the others. She will embrace some new departures in design and construction based upon experiments which have been made with the others and reliable information from abroad, and is to be ready and in working order at the Coronation Naval Review. Considering the difficulties which always attend the production of new types of boats her readiness for active service at such an early date is doubtful. It is not to be quite so fast as the French boats but will have special facilities for rapid rising and descending. One torpedo tube is to be placed at the extreme forward end of the boat, while four 18-inch Whitehead torpedoes are to be carried. The torpedoes may be discharged at any time—whether stationary or running, submerged or awash. Automatic means are provided to control the diving angle and prevent descent to undesirable depths.

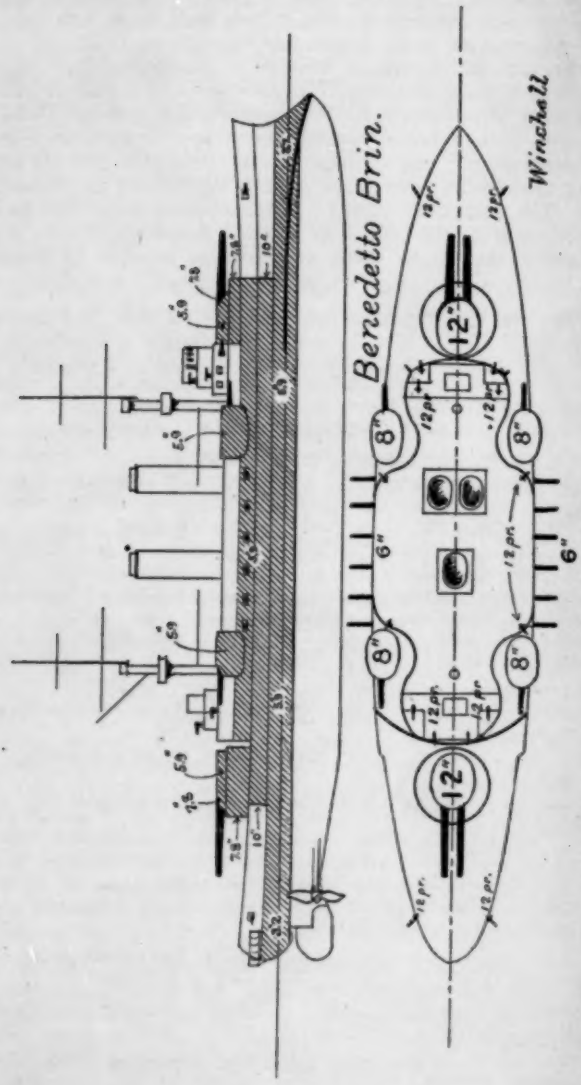
SUBMARINE: TRIAL.—The first submarine to be launched had a trial in the Devonshire and Buccleuch docks on January 8, traversing them from end to end. She will soon be tried in submarine navigation in the open sea.

ITALY.

VESSELS BUILDING.

Name.	Displacement, tons.	Where Building.	Remarks, date of launch, etc.
Battleships.			
A	12,625	.....	Not yet ordered.
B	12,625	.....	" "
C	12,625	.....	" "
Vittorio Emanuele	12,625	Governm't Yard, Spezia.	Not yet launched.
Regina Elena	12,625	Gov. Yard, Castellamare.	" "
Benedetto Brin	13,526	" " "	Launched, Nov. 7, 1901.
Regina Margherita	13,526	" " Spezia.	" May 30, 1901.
Armored Cruiser.			
Francesco Ferruccio.	7,400	" " Venice.	To be lchd. about Apr. 1, '02.
Torpedo Cruiser.			
Coatit	1,313	" " Castellamare	Trials in progress.
Torpedo Boat Destroyers.			
Aquilone	360	C. T. T. Pattison, Naples.	Not yet launched.
Borea	360	" " "	" "
Meteoro	360	" " "	" "
Tuono	360	" " "	" "
Turbine	360	" " "	Launched.
Nembo	360	" " "	Lchd. practically complete.
Torpedo Boats.			
X	..	.....	Not yet ordered.
X	..	.....	" "
X	..	.....	" "
X	..	.....	" "
Submarine Boats.			
X	..	Gov. Yard, Spezia (?).	Building.
Auxiliary Ships.			
Collier	..	.....	"
Collier	..	.....	"
Supply Ship	..	.....	Not yet ordered.

BUDGET, PROGRAM, ETC., 1902-03.—The total amount of the naval budget as presented to the Italian Parliament is 127,165,963.72 lire ($24,543,031.00; 1 lire = $0.193). Of this total, 104,369,406 lire is for the navy proper; 16,630,594 lire for general expenses, pensions, and merchant



NOTE.—For description of the Benedetto Brin, see PROCEEDINGS No. 100, page 770, and No. 99, page 608.

marine; and 6,165,963.72 lire for "*mouvements de capitaux*." The last item is unexplained but a similar item in previous budgets is for (a) equipment of ships in commission and (b) care of crown property given for marine purposes. The sum of 29,169,600 lire is to be devoted to carrying on the construction of the battleships Benedetto Brin, Regina Margherita, Vittorio Emanuele, and Regina Elena, the armored cruiser Francesco Ferruccio, a submarine torpedo boat, two torpedo-boat destroyers, two colliers and two tugs; also for commencing work upon the battleships A, B, and C, of the Vittorio Emanuele class, four sea-going torpedo boats, a supply ship, two water boats of 80 tons and small craft for use at the navy yards. There is, in addition, an allotment of 1,000,000 lire for continuing the reconstruction of the Italia. The sum of 4,500,000 lire is allotted for the purchase of coal and 130,000 tons is to be acquired.

COATIT: ACCIDENT ON TRIAL.—The torpedo cruiser Coatit, 1313 tons, a sister to the Agordat, which is described in PROCEEDINGS No. 98, page 399, commenced trials in the latter part of 1901. On her natural draft trial, while her engines were making 210 revolutions, the starboard began suddenly to race and had to be stopped. It was then found that the screw was broken. No further trials have been reported.

TURBINE: LAUNCH.—The torpedo-boat destroyer Turbine, a sister ship to the Nembo (see next paragraph), was launched at the building yard of Mr. C. T. T. Pattison, Naples, November 21, 1901.

NEMBO: TRIALS.—The torpedo-boat destroyer Nembo has completed her contract trials and is now ready for service. The details of the boats of this type are given in PROCEEDINGS No. 99, page 610, but the immersion is somewhat deeper than there given. With 80 tons of coal on board the displacement is 360 tons, but the trials were made with nearly all weights removed. On the progressive trials, which took place October 9, the mean results of four runs over a measured base were: average time on course, 3 minutes 52 seconds; boiler pressure in pounds, 220; mean I. H. P., 5346; mean speed, 30.038 knots; mean apparent slip of screws, 11.22 per cent. The mean draft on this trial was 5.43 feet and the corresponding displacement, 252 tons. The full-speed trials took place on October 21 under the following conditions: mean draft, 5.57 feet; corresponding displacement, 264 tons; duration of trial, three hours; boiler pressure, about 200 pounds; air-pressure in fire-rooms, 1.2 to 1.57 inches; mean I. H. P., 5278; mean revolutions, 369.11; mean speed, 30.20 knots; mean apparent slip, 11.24 per cent. The six-hour coal consumption trial took place October 28. The displacement was 266 tons, corresponding to a mean draft of 5.6 feet. The boiler pressure was about 200 pounds; speed, 25.12 knots; revolutions, 311.24; I. H. P., 3314; apparent slip, 12.44 per cent. The draft was forced, the air-pressure in the fire-rooms being equal to about 1 inch of water. The coal consumption was 66.54 lbs. per square foot of grate area per hour and 1.95 pounds per I. H. P. The performance of the machinery during the trials was satisfactory.

JAPAN.

VESSELS BUILDING.

Name.	Displacement, tons.	Where building.	Remarks.
Battleship.			
Mikasa	15,200	Vickers-Maxim, Barrow.	Practically complete.
Protected Cruisers.			
Niitaka	3,365	Gov't Yard, Yokosuka.	Building.
Tsushima	3,365	" " Kure.	"
Torpedo Boat Destroyers.			
Asashio	333	Thornycroft, England.	Launched, Jan. 10, 1902.
Asagiri	375	Gov't Yard, Yokosuka.	Not yet launched.
Harusame	375	" " "	" "
Hayatori	375	" " "	" "
Murasame	375	" " "	" "
X	..	.....	Turbine boat; projected.
X	..	.....	" "
X	..	.....	" "
Torpedo Boats.			
Awataki	150	Govt. Yard, Kure	Not yet launched.
Hato	150	" "	" "
Hibari	150	" "	" "
Kari	150	" "	" "
Kiji	150	" "	" "
Tsubame	150	" "	" "
Hashitaka	120	Kawasaki Works, Kobe.	Ordered.
Otori	120	" " "	"
Kamone	120	Govt. Yard, Kure.....	"
Sagi	120	" "	"
Uzuri	120	" "	"
57, 58, 59	80	" "	Nearly complete.
60, 61	83	Kobe; built at Elbing in sections	Probably finished.
62, 63, 64, 65, 66	83	Sasebo; built at Poplar in sections.....	" "
3 boats	88	Govt. Yard, Sasebo.....	Ordered.
2 boats	88	" " Yokosuka..	"

NEW GOVERNMENT IRON AND STEEL WORKS AT WAKAMATSU.—"On November 18 the Imperial Japanese Government Iron and Steel Works were opened at Wakamatsu, the situation of which place will be better understood when it is explained that it is on the northern extremity of the island of Kyushiu, almost facing and about 10 miles by sea from Shimonoseki, on the main island. This position is not only well chosen because of its vicinity to the great coal and ore centers of Japan, but because it offers the best facilities for the reception of foreign ore, of which it is anticipated a considerable quantity will be imported from China and Corea.

The importance of these new works can be gauged from the fact that up to now they have cost the Japanese Government to build and equip 19,200,000 yen, or very nearly two million pounds sterling. This sum includes some £300,000 spent on acquiring certain mines. The works cover an area of 38,000 tsubo—a tsubo equals 36 square feet. The plant consists of the necessary machinery for turning out merchant's iron and steel, in the way of pig, plates, bars, rails, etc.

The machinery comprises, we are told, everything that is new and

improved in the way of German and American machinery for this purpose; but, according to the Japan Mail, 'there is not a single machine of British make' anywhere in the works. This is very unusual in Japanese engineering works at the present day, but doubtless in a colossal factory of this nature, which is quite a novel experience for Japanese engineers, they will for some time to come be guided as to their methods of manufacture by foreign advice, and it is possible that from their point of view they have found it advisable not to mix too much the nationalities of such advisers. The foreign consultant who has had the leading position with regard to establishing these works is Herr Baltzer, and doubtless his advice would be, to order the machinery, as far as possible, from the Fatherland.

Much of the plant is already in active operation. Pig iron is being turned out commercially already, and steel is being made under the Siemens-Martin and other processes.

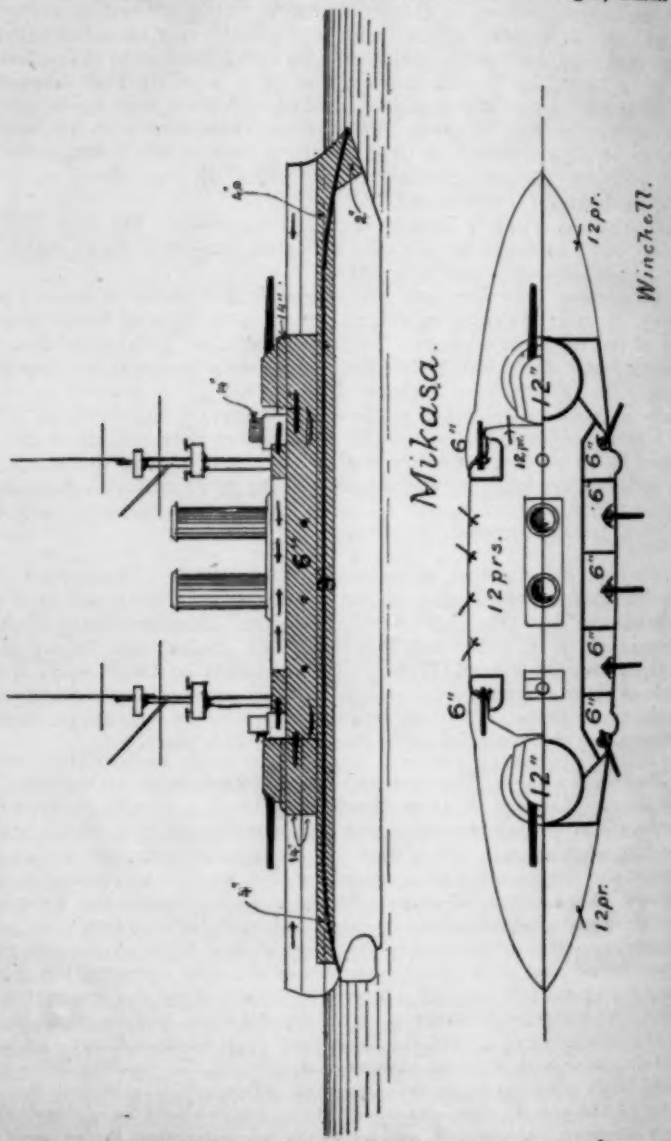
The opening ceremony was performed by a member of the Imperial family, H. I. H. Prince Fushimi in person, at a colossal lunch given in one of the factory buildings. To this repast 1500 guests sat down, including some thirty foreigners, the tables being arranged so that while eating no man turned his back on the Prince.

The promoters of this big engineering enterprise laid down, as one of its ultimate objects, that it should make Japan independent of the foreigner as far as the manufacturing of war material was concerned, and ere long, we are told, the manufacture of the most modern armor plates, and of the biggest guns, will be carried out in this factory."—*Engineer*, London, January 17, 1902.

SAGI, UZURI, KAMONE, HASHITAKA, AND OTORI: ORDERED.—These five first-class torpedo boats of 120 tons and 28 knots speed have been ordered—the Sagi (Heron), Uzuri (Quail), and Kamone (Sea-gull) at the Government yard Kure; and the Hashitaka (Hawk) and Otori (Stork) at the Kawasaki Works, Kobe. The armament of these boats will be made at Kure arsenal and they will be built and equipped with material produced in Japan. The contract price for the two Kawasaki boats is $306,000, and the boats are to be delivered in two years.

MIKASA: TRIAL.—"The new battleship Mikasa, built by Vickers, Sons and Maxim, Limited, at their Naval Construction Works at Barrow-in-Furness, for the Japanese navy, has completed a series of official trials in the English Channel. On a deep sea measured course off the coast of Devon the vessel attained a speed of 18.6 knots, developing a mean indicated horsepower of 16,400, which is in excess of the guaranteed results—namely, 18 knots and 15,000 indicated horsepower. On a coal consumption trial of six hours' duration at four-fifths of the full power it was found that with 12,235 horsepower the coal consumption worked out to 1.53 lb. per unit of power per hour, while the guarantee was 2 lb. The boilers, which are of the Belleville type, were worked entirely by the Japanese crew. On the six hours' trial the speed was 17.3 knots. The engines worked most satisfactorily on all the trials. Progressive speed trials were made on the measured mile course at Stokes Bay, and amongst the results obtained were that 10 knots could be maintained for 2000 indicated horsepower, and 15 knots for a fraction under 7000 indicated horsepower. The ship was at her full draft of 27 feet 2 inches on

an even keel, the displacement being 15,200 tons, and on the circling trials it was found that the diameter of the circle turned, as measured by a Barr and Stroud rangefinder, was only 1½ times her length, which is



400 feet, her breadth being 76 feet. All the guns and torpedoes were tried, these including four 12-inch guns and fourteen 6-inch guns, with twenty 12-pounders, eight 3-pounders, and four 2½-pounders, and four

submerged torpedo tubes."—*Engineer* (London), January 31, 1902. Plans of the Mikasa face this page and a full description of the ship is given in PROCEEDINGS No. 96, page 706.

AKATSUKI: TRIALS.—This torpedo-boat destroyer was built at the works of Messrs. Yarrow & Company. The contract for her construction was signed November 5, 1900; she was launched November 13, 1901; the preliminary trial took place the next day and the official trial on November 21; and the speed on trial was over 31 knots. This is a most remarkable record, but as regards interval between launching and official trial the Kasumi (see next paragraph) beat her by one day. The results of the trials, which are derived from the London *Engineering*, are as follows:

Load carried, 40 tons; runs on the Maplin Mile; weather wet, fresh breeze; sea moderate. Left yard at Poplar, 8.45 A. M.; arrived at Gravesend at 10 A. M.; left Gravesend, 10.11 A. M.; returned to Poplar at 5.20 P. M.

THREE HOURS, OFFICIAL TRIAL, NOVEMBER 21, 1901.

Run	Hour.	Air Pressure in Stokehold.	Revolutions per Minute.	Time.	Speed.	First Mean.	Second Mean.	Admiralty Mean.
	a. m.	in.		m. s.				
1	11.8	1.5	407.0	1 51	32.432	30.779	31.067	31.300 knots on measured mile.
2	11.18	1.5	401.4	2 3.6	29.126			
3	11.28	1.7	414.2	1 47.2	33.582	31.354	31.450	
4	11.38	1.3	403.5	2 2	29.508	31.545	31.368	
5	11.47	1.3	406.5	1 49.5	32.876	31.192	31.315	
6	11.57	1.1	403.5	2 0	30.000	31.438		

Means for the three hours' trial, 230 lb. steam; 64 lb. in first intermediate receiver, 13 lb. in second intermediate receiver; 20.3 in. vacuum; air pressure in stokeholds, 1.3 in.; mean revolutions per minute, 404; mean speed during three hours, 31.121 knots; indicated horsepower, 6450; coal consumption on the three hours' continuous run, 1.97 lb. per horsepower.

The dimensions, armament, etc., of the Akatsuki are given in PROCEEDINGS No. 100, page 771.

KASUMI: LAUNCH, TRIALS.—This torpedo-boat destroyer, a sister to the Akatsuki (see preceding paragraph), was also built by Messrs. Yarrow. She was contracted for at the same time; launched January 23, 1902; had her preliminary trial January 24; and her official trial on January 29. The official trial consisted of a 3-hours' continuous run with a load of 40 tons on board; the speed being ascertained by six runs at the Maplin measured mile. The following is a record of the six measured mile runs:

No. of Run.	Air Pressure in Stokehold.	Revolutions per minute.	Speed	First Mean.	Second Mean.	Admiralty Mean.
1	.6 inches.	395.8	29.032	30.969	30.882	31.075 knots on measured mile.
2	.93 "	392.1	32.906			
3	.9 "	390.3	28.685	30.795	30.941	
4	1.1 "	396.8	33.488	31.087	31.161	
5	1.1 "	398.1	28.985	31.236	31.315	
6	1.2 "	401.7	33.802	31.394		

After these six runs were made, to ascertain the advance per revolution of the screw, a three hours' trial was proceeded with, with the result that a mean speed, during the three hours, of 31.245 knots was obtained.—Data supplied by Messrs. Yarrow & Co.

SHIRAKUMO: TRIALS.—"The torpedo-boat destroyer Shirakumo (White Cloud), which is the first of two vessels now being completed by Messrs. John I. Thornycroft and Co., Limited, for the Imperial Japanese Government, underwent a successful full-speed trial on Saturday, the 4th inst., in very boisterous weather, at the mouth of the Thames. In spite of the unfavorable conditions, the mean speed maintained during the three hours' trial was 31.030 knots. The results of six runs over the measured mile at the Maplin Sands were as follows, the conditions as to loading, etc., being very similar to those for British Admiralty vessels of this class:

Run.	Time. m. sec.	Speed. knots.	Mean Revs. per min.	Steam Press. lb. per sq. in.
1	1 50.8	32.491	394.0	222
2	1 58.6	30.354	394.9	227
*3	1 48.4	33.210	407.4	230
*4	1 50.8	30.822	398.5	235
5	1 49.0	33.027	406.5	235
6	1 58.6	30.354	390.5	235

*True mean speed, 31.819 knots. True mean revolutions, 400.8 per minute.

It will be seen that the mean of runs 3 and 4 is over 32 knots, so that the Shirakumo is one of the fastest vessels in existence. The vessel proved a good sea-boat and noticeably free from vibration."—*Engineering*, London, January 24, 1902.

The dimensions, armament, and other details of the Shirakumo are given in PROCEEDINGS No. 100, page 771.

ASASHIO: LAUNCH.—The torpedo-boat destroyer Asashio, also building at the works of Messrs. J. I. Thornycroft & Company, and a sister boat in all respects to the Shirakumo, was launched January 10, 1902.

NETHERLANDS.

BUDGET FOR 1902.—The Netherlands budget for 1902 amounts to 16,689,195.38 florins ($6,709,056.54; 1 florin = $0.402). The principal items are: materials and construction work, 7,024,825 florins; personnel, 4,583,768 florins; buoyage, pilotage, etc., 2,526,993.50 florins; pensions, etc., 2,106,072.50. New construction is allotted 3,783,000 florins for work on the De Ruyter, Hertog Hendrik, and three torpedo boats.

NORWAY.

BUDGET FOR 1901-02.—The principal items of the budget for 1901-02 are: Administrations, 75,000 crowns; officers of ships, 277,000; medical corps, 45,000; enlisted men and petty officers, 338,000; administration of navy yards, 151,000; naval schools, 390,000; exercises and cruising expenses (including the sum of 30,000 crowns for expenses of mobilization), 1,067,000; new construction, 250,000; maintenance of the material of the fleet, 185,000; torpedo mines, 100,000; ordnance, 150,000; hospital service,

19,000; material for construction, 168,000; expenses of navy yards, 292,000. The value of a crown is $0.268.—*Mittheilungen aus dem Gebiete des Seewesens.*

RUSSIA.

BUDGET FOR 1902.—Complete details of the budget for 1902 have not yet appeared. The total amount decided upon is 98,318,984 roubles ($50,634,276.76; 1 rouble = $0.515), of which 60,500,000 roubles is provided for in the ordinary expenses and 37,818,984 roubles in the extraordinary. In the detailed statement some items are missing.

BUDGET STATEMENT.

Ordinary expenses	60,500,000
Extraordinary expenses	37,818,984
	98,318,984
Shipbuilding and armament	36,903,856
Wages of officers and employees on shore	10,891,845
Expenses of ships in commission	20,485,003
Administration	2,402,674
Establishments of instruction	1,128,638
Medical service and hospitals	1,214,063
Survey of mouths of Yenesei and Obi rivers	54,700
Hydrography and light houses	1,215,809
Expenses of navy yards and workshops	5,740,523
Improvement of Port Imperator Alexander III.	4,026,738
Improvement of Port Arthur	3,200,000
Improvement of Port of Vladivostok	2,000,000
Construction works	5,359,994
Superintendence and direction of ports	2,402,674

VESSELS BUILDING.

Name.	Displacement, tons.	Where building.	Remarks, date of launch, etc.
Battleships.			
X	12,000	....	Projected.
X	12,000	.....	"
X	12,000	.....	"
X	12,000	.....	"
X	12,000	.....	"
Slava	13,516	Baltic Wks., St. Petersb'g	Not yet launched.
Orel	13,516	Galernaia I, "	" "
Knias Suvarov	13,516	Baltic Works, "	" "
Borodino	13,516	New Adm. Wks., "	Launched, Sept. 8, 1901.
Imperator, Alexander III	13,516	Baltic Wks., "	" Aug. 3, 1901.
Tsarevitch	12,900	La Seyne, France.	Launched, Feb. 23, 1901.
Knias Potemkin Tavricbesky	12,585	Nicolaiev, Russia.	" Oct. 9, 1900.
X	12,585	" "	Building, not yet launched.
Pobieda	12,674	Baltic Wks., St. Petersb'g	Nearly ready for service.
Osliabya	12,674	New Admiralty Wks., "	" " "
Admiral Boutakov	5,000	" " "	Not yet launched.
X	5,000	....	Projected.

VESSELS BUILDING—*Continued.*

Name.	Displacement, tons.	Where building.	Remarks, date of launch, etc.
Cruisers.			
Bayan	7,800	La Seyne, France.	Launched June 12, 1900.
Bogatyr	6,750	Vulcan Wks, Stettin, Ger.	" Jan. 30, 1901.
Oleg	6,600	New Adm. Yd., St. P't'sb'g	Ordered.
Kagul	6,250	Gov. Yd., Nicolaiev, Rus.	Not yet launched.
Otshakov	6,250	Gov. Yd., Lazarev, Russia.	" "
X	6,375	Gov. Yd., Libau, Russia.	No recent information. May not have been commenced.
Vitiaz	6,375	Galernaia I, St. Petersb'g.	See note at end of table.
X	6,375	" " "	" "
Askold	6,000	Germania Wks., Kiel, Ger.	Launched March 13, 1900.
Aurora	6,630	Comp. at Franco-Rus'n Wks.	See note at end of table.
Pallada	6,630	Completing.	Practically complete.
Diana	6,630	Completing, Galernaia, I.	" "
X		Schichau, Dantzic.	Not yet launched.
Boyarin	3,000	Burmeister & Wain, Copenhagen.	Launched June 8, 1901.
Kalgoula	3,200	Gov. Yd., Nicolaiev.	Not yet launched.
Almaz	3,200	Baltic Wks., St. Petersb'g.	" "
Jemtchug	3,200	Nevsky Wks., "	Ordered.
Izumrud	3,200	" " "	"
Miscellaneous.			
Kamchatka (Collier)	7,200	New Ad. Wks., St. Petersb'g.	Not yet launched.
Imperial Yacht	(?)	(?)	No recent information.
Okean	12,000	Germania Co., Kiel.	Launched Feb. 8, 1902.
Torpedo Boat Destroyers.			
Baklan	350	Nevsky Wks., St. Petersb'g	Launched, Aug. 12, 1901.
Bekass	350	" " "	Building.
Gorlitsa	350	" " "	"
Kulik	350	" " "	"
Peropel	350	" " "	"
Skvorets	350	" " "	"
Strij	350	" " "	"
Chtchegol	350	" " "	"
Albatross	350	New Ad. Wks., St. Petersb'g	"
Drozd	350	" " "	"
Diatel	350	" " "	"
X	350	Gov. Yard, Nicolaiev.	Ordered.
X	350	" "	"
X	350	" "	"
X	350	" "	"
X	350	" "	"
X	350	" "	"
Osiotr	312	F. et C. de la M., Havre.	Building.
Kefal	312	" " "	Launched Nov. 28, 1901.
Filin	240	Ijora Works, Russia.	Practically complete.
Gagara	240	" "	" "
Krecet	240	" "	Building.
Korsum	240	" "	"
Sowa	240	" "	Practically complete.
Voron	240	" "	" "
Berkut	250	" "	" "
Nyrok	250	" "	" "
Yastreb	250	" "	" "

VESSELS BUILDING—*Continued.*

Name.	Displacement, tons.	Where building.	Remarks, date of launch, etc.
Torpedo Boats.			
Akoula	150	Nevsky Wks., St. Petersb'g	Launched Aug. 24, 1901.
Bytchek	150	" " "	" " "
Keta	150	" " "	Building.
Maknel	150	" " "	"
Nalim	150	" " "	"
Okun	150	" " "	"
Paltus	150	" " "	"
Pescar	150	" " "	"
Plotva	150	" " "	"
Sig	150	" " "	"
X	150	" " "	Ordered.
X	150	" " "	"
X	150	" " "	"
X	150	" " "	"
X	150	" " "	"
Submarine Boat. (Kuteinikov type.)	20	Kronstadt.	Ready for trial.

NOTE.—A serious fire occurred at the Galernaia Island yard on June 13, 1901. The cruiser Vitiaz, which was on the stocks, was completely destroyed, as were numerous small craft. The slip of the battleship Orel caught on fire but it was extinguished and the cruiser Aurora was slightly injured. See PROCEEDINGS No. 99, page 611.

NAVAL SCHOOLS: CONSOLIDATION.—According to *Le Yacht*, the Russian naval schools are to be reorganized and consolidated. The present establishments will be replaced by a single school divided into sections for the executive officers, marine engineers, torpedo officers, etc. This community of instruction is expected to augment the comradeship between the different corps.

NAVAL BALLOON SERVICE.—"The minister of marine is going to develop a naval balloon service. For this purpose officers and petty officers will be detailed for special instruction in the *parc aerostatique*. This determination of the minister of marine has been taken because of the excellent results of the experiments recently made with balloons by the Black Sea fleet."—*Moniteur de la Flotte*, February 8, 1902.

OLEG: COMMENCED.—The new cruiser of the Bogatyr type, which was recently commenced at the New Admiralty Works, St. Petersburg, will be called the Oleg. The armament consists of twelve 6-inch guns, six 3-inch, and six 3-pounders. The armor of the turrets is 5 inches thick and of the casemates 3.5 inches. The protective deck is from 1.57 to 3 inches thick. The designed speed is 23.5 knots. The length is 416.5 feet; beam, 54.4 feet; draft, 20.7 feet; displacement, 6600 tons.

JEMTCHUG, IZUMRUD: ORDERED.—These fast cruisers of the Novik type have been ordered and are building at the Nevsky Works, St. Petersburg. The designed I. H. P. of the machinery is 17,000 and the expected speed is 25 knots.

OKEAN: LAUNCH.—This vessel, which is referred to as a collier and school for firemen and briefly described in PROCEEDINGS No. 99 (page 613), was launched February 8, 1902.

POBIEDA: TRIALS.—The trials of the battleship Pobieda, 12,674 tons, which took place on October 14 and which are referred to in PROCEEDINGS No. 100, page 774, were very successful. The I. H. P. developed by the starboard engine was 5198; by the port engine, 5049; and by the central engine, 5245; total, 15,492, instead of 14,500, which was the contract requirement. The mean speed developed was 18.5 knots.

DIANA, PALLADA: TRIALS.—The full-speed trial of the protected cruiser Diana, 6630 tons, took place in the latter part of 1901. The I. H. P. developed was 12,129—529 in excess of the designed power; and the speed was 19.3 knots with 131 revolutions. The Pallada's trials took place November 13. The speed maintained was 19.2 knots with 11,600 I. H. P. These vessels were designed for 20 knots speed with 11,600 I. H. P. but it is evident that not less than 13,000 will be necessary.

BOGATYR: PRELIMINARY TRIAL.—The preliminary trials of the cruiser Bogatyr, 6750 tons, took place in the latter part of 1901. The I. H. P. developed was 20,500 and the mean speed was about 24 knots. The official trials are expected to take place in April. A full description of the Bogatyr with plans and illustrations is given in PROCEEDINGS No. 97, pages 177a, 182, and 182a.

NOVIK: DESCRIPTION, TRIAL SPEED.—"*Ueberall* gives some particulars of the Russian cruiser Novik, which has now been handed over to the Russian Government by the firm of Schichau, after undergoing her trials, at which she made a speed of 26 knots. The type of vessel required was precisely laid down by the Russian Admiralty, the chief characteristics demanded being a speed of at least 25 knots, an armament and armor as heavy as possible, combined with a small displacement and thorough sea-going qualities. With regard to the build of the vessel, it was to have a small freeboard and superstructure so as to offer but little target to the enemy's fire, as well as to prevent her being too readily observed. It was evident therefore that she was intended to be used for scouting purposes. But this, again, required a large radius of action and good accommodation for the crew. All these various requirements made it difficult for the Russian Government to find a firm willing to undertake the work, but finally the plans of Schichau were accepted as satisfactory. The weak part of the design is that it does not permit of the powerful engines, 18,000 horsepower, being entirely below the water-line. They cannot, therefore, be covered by the 50 millimeter (nearly 2 in.) armor deck, but protrude above it, where they are protected by an armored dome. The bunker capacity of 900 tons allows of a radius of action at full speed of 900 miles, that distance being travelled in less than 36 hours, or a radius of 5000 miles at a speed of 14 knots. Her armament consists of six 4.72-in., twelve 1.85-in., two 1.45-in., and one 2.44-in. Baranovski gun, and also five torpedo tubes. The three engines and the 12 water-tube boilers are of the Schichau type. Her trials were made in very rough weather, during which she proved herself thoroughly seaworthy. She has usually been spoken of as a destroyer of torpedo-boat destroyers. Her length is 347 ft., 8 in., beam 40 ft., and draft 16 ft., 5 in."—*Engineering* (London), February 7, 1902.

KEFAL: LAUNCH.—This torpedo-boat destroyer of 312 tons was launched at the yard of the Forges et Chantiers de la Mediterranée at Havre, November 28, 1901. The Kefal is fully described in PROCEEDINGS No. 97, page 183.

YASTREB: TRIAL.—The torpedo-boat destroyer Yastreb, 240 tons, 3800 I. H. P., built at the Government yard, Ijora, has completed her full-speed trials. The mean of two runs over the measured mile was 26.84 knots; and the mean speed during a 4-hour run was 26.50 knots with 352 revolutions.

TORPEDO BOAT SENT TO VLADIVOSTOK.—One of the torpedo boats of 150 tons of the Cyclone (French) type which are building at Nevsky Works will be sent to Vladivostok in sections and put together there.

TORPEDO BOAT AT PORT ARTHUR: TRIAL.—A small torpedo boat, which has been built, or partly built, at Port Arthur, has recently had its trials, attaining a speed of 22 knots.

KOUTEINIKOV-KOLBASIEV SUBMARINE BOAT: DESCRIPTION.—The Russian submarine boat, which is being built on the plans of Engineer Kouteinikov and Lieutenant Kolbasiev, differs from all existing types. It is composed of nine sections joined together by bolts and which may be taken apart. Its length is 50 feet; diameter, 4 feet; and its displacement is 20 tons. The three middle sections contain the machinery. It will have six screws driven by electric power, the current being furnished by accumulators of the Bari system, which will be placed in the three forward and three after sections. These same sections can be filled with water to sink the boat. The forward and after sections carry appendages in the form of wings which serve to steer the torpedo and keep it properly pointed. The armament will consist of two torpedoes which occupy the length of three sections. All the sections are completed; three have been put in the water and have been subjected to high pressure with excellent results. The boat will be completed and make its trials at the end of the year. When it is inclined 90° it rights itself immediately.—*Army & Navy Register*, September 21, 1901.

SPAIN.

BUDGET.—The naval Budget recently presented to the Cortes appropriates about 11,000,000 pesetas for continuing the construction of vessels now building, and for improvements in the arsenals of Cartagena and Carraca, divided as follows: Armored cruiser Cardenal Cisneros, 933,000 pesetas; Cataluna, 2,262,500; Princesa de Asturias, 1,875,000; protected cruiser Reina Regente, 2,887,500; Estremadura, 192,500; torpedo gunboat Dona Maria de Molina, 97,500; Marques de la Victoria, 165,000; Don Alvaro de Bazan, 202,500. Concerning the budget, the *Army and Navy Gazette* of December 7, says: "The Spanish Ministers of Marine and Finance have at length come to an agreement, in regard to expenditure, with the Committee of the Cortes, and additional credits of half a million sterling are recommended as necessary for carrying out the work in progress on nine war vessels which are being built in the State yards. These credits are to be included in the ordinary Naval Estimates

for next year, and are increased from under one million sterling to £1,450,000. The Government now feels more confident of getting the Budget voted and gazetted before January 1. The naval arsenals are to be reorganized and specialized. That at Carraca, near Cadiz, will be divided into three distinct parts, one devoted to the smaller class of ship-building, another to ordnance, and the third to coaling and victualling. The arsenals of Ferrol and Cartagena will undertake nothing but naval construction, and at Carraca will be the sole artillery depot, all establishments having relation to ordnance being transferred. Ferrol will not, except in case of war, repair or put in hand ships of less than 5000 tons displacement, while Cartagena will be reserved for work upon smaller vessels, and there and at Carraca ships' boats are to be constructed. It is believed that these arrangements, will enable needful economy to be made."

The ninth vessel, which is not mentioned among those for which money is allotted, is the General Linares, a sister ship to the Rio de la Plata.

COMMITTEE TO PREPARE A NEW BUILDING PROGRAM.—"The *Rivista General de Marina* publishes a Royal decree signed by the Queen Regent in the name of her son, creating a special committee, which, within as short a time as possible, is to propose to the Government a programme for the constitution of a national squadron, indicating the types of various classes which should constitute it, as well as the approximate cost. The committee is also to consider whether it would be advisable to construct the ships intended to be built in the national arsenals or to acquire them from private constructors at home or abroad, or in what proportion the two methods might be adopted. The Government will submit to the Cortes the dispositions suitable for the creation of a squadron provided with the essentials for national defence, and will indicate proposals for the financial arrangements to be made. The same publication has an article, by a Lieut. Pasquin, of the Spanish Navy, upon the right constitution of a fleet for the nation, in which he asks for at least ten battleships of from 10,000 to 11,000 tons, and 100 various torpedo craft, besides some cruisers and scouting vessels. He believes that an outlay of 400 millions of pesetas would be involved."—*Army and Navy Gazette*, February 15, 1902.

ESTREMADURA: BATTERY.—The battery for the new cruiser Estremadura (2030 tons), consisting of eight 101-millimeter (4-inch) guns of 50 calibers length, four 6-pounders, two 1-pounders, two Maxim machine guns, and two 75-milllimeter (2.96-inch) landing guns, will be supplied by Messrs. Vickers, Sons and Maxim. The 101-millimeter guns will have a muzzle velocity of 3000 feet per second and the speed of fire is to be 10 rounds per minute. Metallic cartridge cases will not be used for these pieces.

SWEDEN.

BUDGET.—The Swedish naval budget for 1902 amounts to 21,445,025 crowns ($5,747,266.70; 1 crown = $0.268), of which the sum of 10,461,982 crowns is placed in the ordinary expenses and 10,983,043 crowns in the extraordinary, the former being increased by 2,331,027 crowns and the latter decreased by 2,439,062. The items of the ordinary budget are:

1. Ministry of Marine, 93,400 crowns. 2. The fleet, 6,996,110—of which the personnel takes 3,851,740; materials, 1,685,000; schools, 53,400; armaments and practice cruises, 1,361,900; and medical service and hospitals, 44,000. 3. Coast artillery, 1,479,496. 4. Miscellaneous expenses, 1,479,496. 5. Merchant marine, 1,688,209. In the extraordinary budget, the fleet has a total credit of 8,932,765 crowns, of which 6,639,915 is for the acquisition of war material; 280,000 as a second allotment for the rebuilding of the monitors Thordön and Tirfing; 107,900 for the transformation of torpedo transports into boats for patrol service; 1,206,000 as a second allotment for supplies and torpedo outfit of the armored ships A, B, and C; 15,000 for firing trials; 5000 for torpedo trials; 80,000 for acquiring reserve torpedo material; 50,000 for the purchase of torpedo mines; 50,000 for torpedo defences; 290,000 for the purchase of coal; and 105,500 for the purchase of clothing, these two last-named items being for the mobilization. In the credit of 6,639,915 crowns for war material are comprised the new construction of which the allotments are as follows: 1,835,865 crowns for the completion of the armored ships A, B, and C; 598,050 as first instalment for three first-class torpedo boats and two second-class boats; for the construction of a torpedo-boat destroyer; 2,813,000 as first instalment for the construction of an armored ship of the first class; 181,000 for the purchase of a vessel to carry a balloon.

New Armored Ship: Ordered.—This vessel, which is to cost 5,625,000 crowns, has been ordered of the Kockum Company at Malmo. She will probably closely resemble the Äran and Vasa class.

Torpedo-Boat Destroyer: Ordered.—The torpedo-boat destroyer mentioned in the budget has been ordered of Messrs. Yarrow and Company, Poplar, England. The contract price is £48,300 ($235,051.95) and the principal details are:

Armament.—Six 6-pounders. Two torpedo tubes.

Motive Power.—Twin-screw, 4-cylinder, triple-expansion engines designed to give a speed of 31 knots; for each quarter of a knot in excess of 31, an addition of £500 will be made to the contract price. The load on trial will be 35 tons and the air-pressure allowed in the fire-rooms not to exceed 3 inches of water. Four Yarrow water-tube boilers. Coal is to be used for fuel but provision is to be made for burning oil if desired.

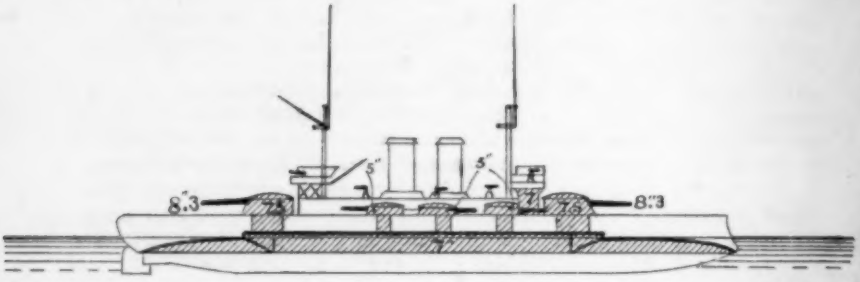
Dimensions.—Length, 220 feet; beam, 20.5 feet; draft, 6.5 feet; displacement, 320 tons.

Äran, Tapperheten, Vasa: Description, Launch.—These little coast-defence armorclads are all under construction in Sweden; the Äran at the Motala-Lindholm Works, Gotaborg; the Tapperheten at the Kockum Works, Malmo, and the Vasa at the Bergsund Works, Stockholm (Finnboda). They are all reported to have been launched between August and November, 1901. The hulls are of steel without sheathing, and the general appearance may be understood from the plans on the next page. The complement is 250.

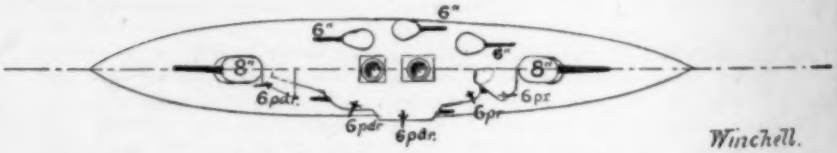
Armament.—Two 8.27-inch guns in closed turrets, one forward, one aft. Six 5.9-inch guns mounted singly in closed turrets, three each side; as will be seen from the plans four of these guns can be fired directly

ahead and four directly astern. Ten 6-pounders, one each side on the forward and after bridges and three each side on the superstructure. Two 1-pounders for boat guns. Two submerged torpedo tubes, one each side about abreast foremast. Four 35.4-inch searchlights are carried. The 8.27-inch and 5.9-inch guns are to be furnished by the Bofors Works and the smaller pieces by the Stockholm Vapen-Fabrik and the Finspong Works.

Protection.—Partial water-line belt, 165 feet long and 6.9 inches thick. Complete protective deck, 1.9 inches thick. Turrets of 8.27-inch guns are 7.5 inches thick in front and 5.9 inches in rear; turret bases 7.5 inches, except after plate which is 5.9 inches. Turrets of 5.9-inch guns, 4.9 inches in front and 2.4 inches in rear; turret bases and loading tubes, 3.9 inches.



Äran.



Winchell.

Conning tower, 6.9 inches; conning tower shield, 3.9 inches. All armor is Krupp face-hardened.

Motive Power.—Twin-screw engines in separate compartments; using steam at 209 pounds (natural draft), designed to develop 5500 I. H. P. and give a speed of 16.5 knots. Eight Yarrow water-tube boilers; total heating surface 15,610 square feet; grate area, 376.8 square feet. Total weight of propelling machinery, including screws, shafts, boilers, pumps, etc., is not to exceed 947,978 pounds, and the coal consumption per I. H. P. per hour when developing 5500 I. H. P. is not to exceed 1.87 pounds. Coal supply at load draft, 250 tons; total capacity, 375 tons.

Auxiliary Machinery.—Steam and hand steering gear. The electric installation consists of three generators; one of 200 amperes for interior lighting (281 incandescent lamps); one of 400 amperes for searchlights; and one of 500 amperes for motors.

Dimensions.—Length at the water-line, 287 feet; beam, 49.3 feet; draft, forward and aft, 16.4 feet; displacement, 3650 tons.

UNITED STATES.

VESSELS BUILDING (March 1, 1902).

GIVING PER CENT. COMPLETED OF TOTAL WORK REQUIRED TO BUILD THEM.

Battleships.

No.	Name (displacement)	Per cent. completed	No.	Name (displacement)	Per cent. completed
10	Maine (12,500 tons)	84	14	Nebraska (14,600 tons)	0
11	Missouri (12,500)	58	15	Georgia (14,600)	7
12	Ohio (12,500)	55	16	New Jersey (14,600)	7
13	Virginia (14,600)	0	17	Rhode Island (14,600)	7

Armored Cruisers.

4	Pennsylvania (13,600 tons)	17	7	Colorado (13,600 tons)	20
5	West Virginia (13,600)	10	8	Maryland (13,600)	9
6	California (13,600)	1	9	South Dakota (13,600)	1

Protected Cruisers.

14	Denver (3,100 tons)	74	19	Cleveland (3,100 tons)	76
15	Des Moines (3,100)	65	20	St. Louis (9,600)	3
16	Chattanooga (3,100)	56	21	Milwaukee (9,600)	0
17	Galveston (3,100)	53	22	Charleston (9,600)	1
18	Tacoma (3,100)	40			

Monitors.

7	Arkansas (3,214 tons)	92	9	Florida (3,214 tons)	88
8	Nevada (3,214)	92	10	Wyoming (3,214)	80

Torpedo Boat Destroyers.

1	Bainbridge (420 tons)	99	9	McDonough (400 tons)	98
2	Barry (420)	97	10	Paul Jones (420)	85
3	Chauncey (420)	98	11	Perry (420)	89
4	Dale (420)	98	12	Preble (420)	87
5	Decatur (420)	99	13	Stewart (420)	65
6	Hopkins (408)	82	14	Truxton (433)	86
7	Hull (408)	81	15	Whipple (433)	83
8	Lawrence (400)	99	16	Worden (433)	83

Torpedo Boats.

19	Stringham (340 tons)	98	30	O'Brien (174)	98
20	Goldsborough (247.5)	93	33	Thornton (165)	98
27	Blakely (165)	98	34	Tingey (165)	74
28	DeLong (165)	98	35	Wilkes (165)	94
29	Nicholson (174)	97			

Submarine Torpedo Boats.

1	Plunger (120 tons)	80	6	Pike (120 tons)	57
3	Adder (120)	98	7	Porpoise (120)	92
4	Grampus (120)	62	8	Shark (120)	68
5	Moccasin	96			

NAVAL ACADEMY: NEW QUARTERS FOR CADETS, ARMORY, AND BOATHOUSE.—The contract for building the new cadet quarters at the Naval Academy was awarded to Neil & Thomas of Baltimore at their bid of $2,448,000, contract time two years. Work was commenced in January but the heavy snows and cold weather have delayed the actual building. The armory is now nearly complete on the outside and the boathouse is not very far behind. The Secretary of the Navy has extended the time for the completion of these two buildings until July 30, 1902.

ENGINEERING EXPERIMENTAL STATION.—"The Navy Department will give its cordial support to a plan, originating in the bureau of steam engineering, which contemplates the erection and equipment of a building at a cost of $400,000 for experimental work in the Navy. It is proposed to establish an institution at Annapolis on the Naval Academy reservation, where will be conducted work and instruction in engineering science. It is planned to have this station operate in conjunction with the post-graduate course of engineering and which will undoubtedly soon be established by the academy. There are many important questions awaiting investigation, and it is to the consideration of these that the proposed experimental station will devote its labors. A few of the questions which will be presented to the station when it is ready for work are the means of utilizing liquid fuel, the value of the steam turbine for naval purposes, the form, size, location and shape of propellers, the employment of electricity in the Navy, the corrosion of boiler and condenser tubes, the form and type of water-tube boilers, the use of compressed air as a motor, the balancing of marine engines, the development of the storage battery, the improvement of the gas engine and other technical questions of vital import to the Navy. Incidentally, it is proposed by Rear Admiral Melville that the station at Annapolis shall be used in the testing of the numerous patented appliances which are offered by the inventors for government test, the examination and trial of which may prove of benefit to the naval service. The Navy Department will, therefore, report favorably upon the project and will use the influence of its recommendation in behalf of the institution."—*Army and Navy Register*, January 11, 1902.

HYDROGRAPHIC OFFICE: NEW BUILDING.—"Secretary Long will make an effort during the coming session of Congress to have an appropriation of $230,000 made for the purchase of land and the erection of a building for the use of the naval hydrographic office."—*Army and Navy Register*, January 4. The present quarters are divided between the basement of the navy department and an old building at the corner of 17th Street and New York Avenue and are not only inadequate but very inconvenient. The division of chart construction is in the rented building and every chart plate has to be carried back and forth when needed for printing in order that they may be stored in a fire-proof building. The other divisions have about reached the limits of their present quarters and the crowding of the shelves and floor space is seriously interfering with the work.

PEARL HARBOR NAVAL STATION.—"Condemnation proceedings are being conducted by the civil courts in Honolulu with a view to the acquirement by the government of a tract of land at Pearl Harbor. The managers of the plantation now occupying the territory estimate the value of their leasehold interest at about $400,000. One of the questions submitted to the court was the dock rights of the defendants, but the court, after inquiry, ascertained from the government records that an original treaty was made between the United States and the King of Hawaii in 1887 when the King granted to the United States all the water rights of Pearl Harbor then known as Pearl River. The court has held that the United States owns all riparian rights at that place."—*Army and Navy Register*, February 1, 1902.

Arrangements are being made for the establishment at Pearl Harbor in the Hawaiian Islands of a naval station, roughly estimated to cost the government $5,000,000. The preliminary surveys are now being made under the direction of Civil Engineer U. S. G. White of the Navy. The reports which have been received indicate that land suitable as a dock site can be obtained at a moderate cost. The Navy Department is at present allotting sums of money for the temporary quarters and barracks for that part of the Navy which is stationed in the Hawaiian Islands. It is hoped to receive the reports from Pearl Harbor in time to make the estimate to the present Congress."—*Army and Navy Register*, January 11, 1902.

POLLOK NAVAL STATION.—"The Navy Department is developing its new naval repair station at Pollok which is situated on an indentation of the western coast of Mindanao, P. I. This is the first time that most people have heard of a naval station at that place but it seems to be a promising establishment, possessing a crippled machine shop and a broken down dry dock. It belonged to the Spaniards in that time of lackadaisical administration which fell like a blight upon all public institutions in the Philippines or any where else that the Spaniards maintained a repair or construction plant. The Navy Department has allotted small sums of money for the carrying on of the work at Pollok, and Rear Admiral Remey has this week asked for the detail of a civil engineer. E. O. Maxson of the corps, who has been on duty in Boston, is now en route to the Philippines, where he will be completely occupied with the work at the naval station at Cavite and will not have time to superintend the repair work at Pollok. Secretary Long has promised to consider favorably the detail of a civil engineer for Pollok, but there are no civil engineers available for that or any other extra duty. The dry dock at Pollok is a small affair but it will be useful in the docking of such types as torpedo boats, tugs and the small gunboats."—*Army and Navy Register*, December 21, 1901.

NEW BATTLESHIPS AND CRUISERS.—The general features of the new battleships are given in No. 100, page 779. The full details are now available and will be published in No. 102, together (if possible) with the general plans and illustrations of the ships as they will appear when completed.

MISSOURI: LAUNCH.—The battleship Missouri, 12,300 tons, was launched at the yard of the Newport News Shipbuilding Company on December 28. She is a sister ship in all respects except minor details and boilers to the Ohio and Maine, fully described and illustrated in PROCEEDINGS No. 98, page 403.

FLORIDA: LAUNCH.—The monitor Florida, 3235 tons, was launched at the Crescent Shipyard, Elizabethport, N. J., November 30, 1901. She is a sister ship in all respects to the Wyoming, fully described in PROCEEDINGS No. 96 page 717.

ILLINOIS: FINAL ACCEPTANCE TRIAL IN COMMISSION.—The report of the Board of Inspection and Survey on the final trial of the Illinois has been submitted to the Navy Department. In regard to the trial the *Army and Navy Journal* of February 22 says:

"A report of the Board of Inspection and Survey on the trial of the U. S. S. Illinois on Feb. 11 and 12 from Hampton Roads to New York has been submitted to the Navy Department. With the exception of a few minor details the hull, machinery, and workmanship are found to be in good condition, and there was no failure or break down. The members of the board present were Capt. C. J. Train, Capt. J. N. Hemphill, Naval Constr. J. J. Woodward, Comdr. C. R. Roelker, Comdr. C. E. Vreeland, and Lieut. Comdr. T. S. Rodgers. We make the following extracts from the report:

"During the two-days' trial, the Board made a complete examination of all parts of the ship. No parts of the machinery were found to be defective nor showed any deterioration other than that due to fair wear and tear, except that the port H. P. cylinder stuffing box was leaking excessively and that the starboard H. P. cylinder piston rings were evidently leaking, but neither of these defects are apparently due to defective material or workmanship and therefore not chargeable to the contractor. No work on the machinery, required by contract and specifications and authorized changes therein, is at present unsatisfactorily completed.

"During the two-hours' full-power speed trial under natural draft, the following was among the data of the performance of the engines taken: Mean revolutions of both engines, 101.4. Steam pressure in boilers, 161 lbs. Pounds of coal (New River) per hour, 16,170 lbs. Temperature, fireroom, 83. Grate surface in use, 685 sq. ft. I. H. P. main engines, 4524.4—4127.5. I. H. P. both engines, 8652.0. I. H. P. auxiliaries, 1500. Aggregate I. H P. during two hours' trial, 8802.0. Mean draft at beginning of trial, 25 feet 6 inches. Displacement, 12,700 tons.

"On account of the extreme cold, the guns and their mounts being covered with ice, it was considered inadvisable to fire the guns and the report of the firing of Dec. 4, 1901, was accepted by the Board as satisfactory evidence that the guns, gun-carriages and their fittings and appurtenances work properly, and that the vessel is sufficiently strong to stand the shock caused by firing. On the morning of the second day, a test was made of the rapidity of fire of one of the 6-inch guns, and six unaimed shots were fired in three minutes—the ammunition being at the magazine door at the commencement of the trial.

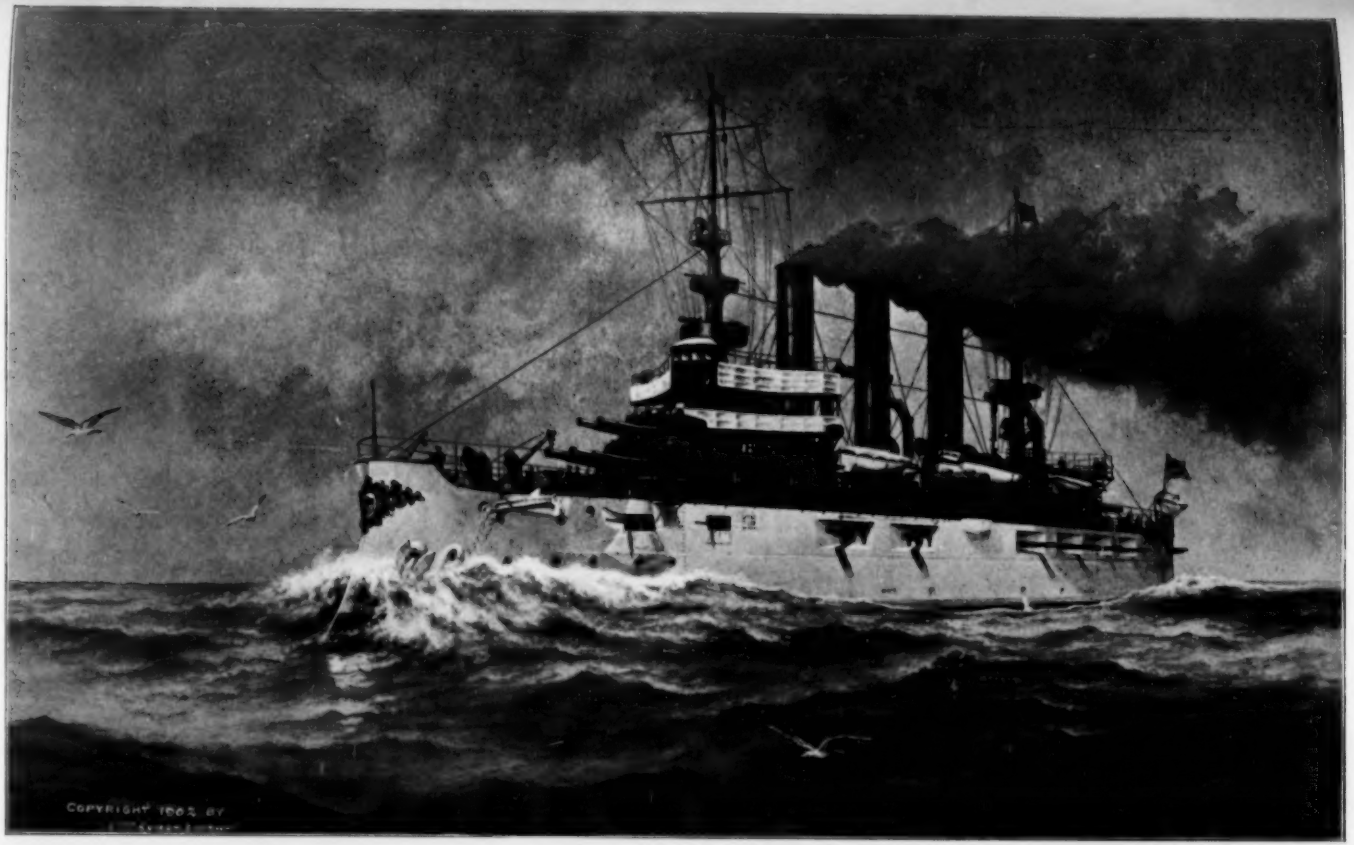
"The Board recommends changes, not chargeable to the contractors, be made at the first convenient opportunity. These deal with increased ventilation, electrical whip hoists, wood work in store room, etc.

"There are also certain items of work to which it is desired to call the Department's attention, as affecting the design of similar fittings in vessels under construction. These relate to guns and fittings.

"A number of additions in electrical department are recommended.

"Finally, the Board reports that during the trial no weakness or defect in the hull, fittings or equipment, due to either defective workmanship or defective materials, or in the fitting, fixing, placing and securing of the armor, due to defective workmanship appeared, except as noted in the report.

"That the machinery and all parts thereof was found to be in good condition with respect to workmanship or materials, and that there was no failure, breaking down, nor deterioration, other than that due to fair wear and tear, of any part or parts of the machinery, engines, boilers or appurtenances."



U. S. S. NEW JERSEY.

FOR DESCRIPTION SEE PROCEEDINGS No. 96.

DECATUR: TRIAL.—The torpedo-boat destroyer Decatur, 420 tons, had her final trial in Chesapeake Bay on December 12. The average speed for the two-hours' run was 28.144 knots. The Decatur is a sister ship in all essential respects to the Bainbridge, which is described in PROCEEDINGS No. 100, page 781.

PLUNGER: LAUNCH.—The submarine torpedo boat Plunger was launched at the Crescent Shipyard, Elizabethport, N. J., on February 1. She is a sister boat in all respects to the Moccasin, which is fully described in PROCEEDINGS No. 99, page 622.

NEWARK, BALTIMORE: RECONSTRUCTION.—The protected cruiser Newark, 4098 tons, is being very extensively repaired and refitted at the Boston Navy Yard. Her coal capacity will be increased and her battery changed. Her twelve 30-caliber 6-inch guns on gravity return carriages will be replaced by new 6-inch 40-caliber guns on pedestal mounts. In the case of the Baltimore, her old battery of 6-inch and 8-inch guns will be removed and a new battery of twelve 6-inch will be supplied. The Baltimore's smaller pieces will be six 3-inch of 50 calibers, six semi-automatic 3-pounders, four 1-pounders, four Colt guns of .30-inch caliber, one 3-inch field piece, and one gatling of .30-inch caliber.

MAHOPAC, MANHATTAN: SOLD.—The old monitors Mahopac and Manhattan have been sold, the price bid being $15,218 in each case. They were appraised at $8736 and $8516 respectively. The Vermont was offered for sale at the same time, but as the highest bid was $3000 less than the appraised value she was not sold.

AMMUNITION.

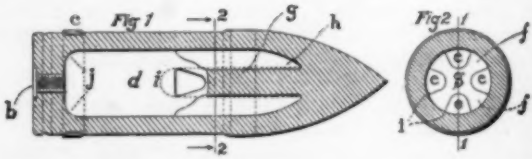
NEW ARMOR-PIERCING SHELL FOR U. S. NAVY: TEST.—"The Naval Bureau of Ordnance has recently conducted tests at the Indian Head proving grounds of an improved shell for the Navy. It is said that this shell is capable of perforating armor of a thickness equal to its own caliber and carrying a heavy charge of high explosive. The shell was fired in the test from a six-inch gun at armor plate six inches in thickness. It went completely through the plate, but broke into small pieces on the other side. Officers of the Navy, who were present, believe that the defect of breaking immediately upon passing through the plate can be overcome."—*Army and Navy Journal*, January 4, 1902.

DAVIS ARMOR-PIERCING SHELL.—The following description appears in *Arms and Explosives:* "An explosive shell for ordnance, so designed that it shall give a maximum perforating power consistent with a maximum capacity for an explosive charge. It is necessary, in order that the character of this invention may be grasped, that the action of projectiles upon impact on face-hardened armor plate should be understood. When the point of the projectile meets the hard face of the armor plate, an elastic dishing of the surface is caused. The stress of the impact is transmitted to the tough back of the plate, and the whole area of depression is concentrated to resist the advance of the projectile. This resistance tends to stop the projectile, or materially to reduce the veloc-

ity in a short space. The projectile is thus caused to expend its energy upon itself, the tendency being to break it up along its weakest lines.

"The patentee has observed that when an ordinary shell strikes a plate which it cannot penetrate, it is first bulged. It then gives way along longitudinal lines in strips evenly distributed around the circumference of the bourrelet. Disruption along transverse lines follows, the tendency to complete rupture being enhanced by the rotation of the projectile. Sometimes, when the point of the shell enters a plate, the head is held fast, and the tendency of the body to continue to rotate causes a break-off at the rear of the apex.

"From these observations the patentee concludes that the increase of metal in the walls of the shell causes the bulging, when the velocity of the shell is checked in a short space. Therefore, he so designs the interior of his shell, that while the capacity for containing a bursting charge is increased, the penetrating power is increased. Roughly, to obtain this improvement, the weight of metal is concentrated in the line of attack.

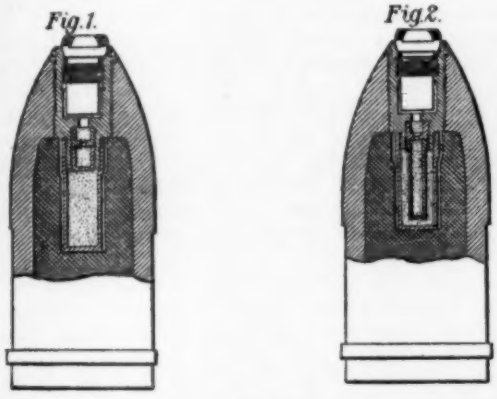


"In the accompanying drawings, *a* represents the shell, *b* the fuse, and *c* the driving band. The interior of the shell consists of a large chamber *d*, terminating in the front half of the shell with four longitudinal chambers *e*, which are separated from each other by the webs *f*, which connect the central portion *g* with the body of the shell. The construction will be easily understood on referring to Fig. 1, which is a longitudinal section along the lines 1—1, Fig. 2; and to Fig. 2, which is a transverse section along the line 2—2, Fig. 1, looking in the direction of the arrows. It will be noticed that the interior of the shell is as free of angles as is possible, the points of connection being curved, as at *h*, *i*, *j*.

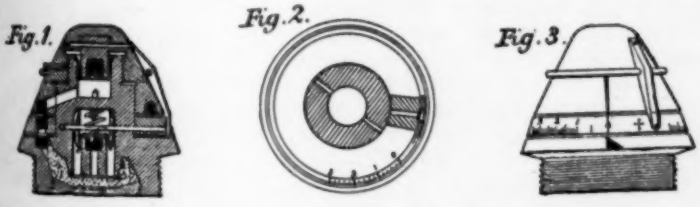
"The advantages claimed for this form of shell are: increased penetrating power for the same weight of shell; increased capacity of the interior to contain a bursting charge; improvement in quality due to its form, which makes it more susceptible to treatment from a metallurgical aspect; and improvement as regards disruption upon ignition of the bursting charge, whereby the shell will break up into a relatively greater number of pieces. British patent accepted Dec. 7, 1901."

GUNPOWDER FUZES FOR SHELL: KRUPP SYSTEM.—Krupp's British patent (No. 1322, accepted November 13, 1901) is briefly described in *Engineering* as follows: "In order to diminish risk in handling and firing shells, one part of the fulminate—namely, that heretofore used locally to detonate the charge—is dispensed with, and in its place a series of frangible vessels, containing gunpowder and in close relation to each other, is used. It is stated that "the fuze is made to explode first the front portion of the igniting charge (which may be conveniently enclosed

in a thick-walled chamber), this immediately explodes the second portion, and so on, the explosions thus obviously becoming more and more violent, so that the last is sufficiently violent in its action to readily detonate the bursting charge."



SHELL FUZE: KRUPP'S SAFETY DEVICE.—This device as developed in the British patent (No. 1323, accepted November 27, 1901) is briefly described in the patent record of *Engineering* as follows: "This invention relates to compound fuzes, and is designed to enable the movable parts of both time and percussion fuzes to be secured by a safety device while the projectile is carried about; the said safety device is adapted for removal by a single movement of the hand when it is desired to put the compound fuze into action. This end is attained, according to the present invention, by providing the compound fuze with two pins connected



by a cross-piece, one of which secures the priming bolt of the time fuze, and the other the moving parts of the percussion fuze. One pin may pass through the revolving powder ring, and secure it against motion (preferably in the case shot position), so that the pinhole leading to the percussion fuze shall, when the powder ring is in any other position, be covered thereby, and the entrance of dirt and the like to the percussion fuze be prevented."

HIGH EXPLOSIVES FOR SHELLS: U. S. ARMY REPORTS.—In the special bimonthly report of the ordnance board of the U. S. Army, under date of January 1, 1902, the following appears:

"In connection with the unfavorable reports upon the 3.2-inch steel shell for high explosives, maximum capacity charged with a mixture of thorite and black powder, from officers serving in China and the Philippines, and the general demand expressed by these officers for an effective high explosive field shell, the department has prepared a design for a 3.2-inch field shell of maximum capacity to contain a high explosive bursting charge. A lot of 1100 of these shell is now under manufacture to be issued for trial in service. The shell are fitted for a point detonating fuze.

"New designs of 5- and 7-inch steel high explosive shell for the siege service have been prepared which will contain a maximum charge of high explosive consistent with necessary strength of projectile. They are fitted for a point fuze. Lots of 50 projectiles each for 5-inch siege gun and 7-inch howitzer are under manufacture to be tested at the proving ground with a view to the adoption of this pattern of projectile in service.

"A special axial vent friction primer, with diameter of 0.25-inch, has been prepared for firing the 1-pounder sub-caliber tube. This primer contains 15 grains of powder in place of 7½ grains in the ordinary axial vent primer.

"The status of high explosives for field shell is practically the same as stated in the board's report of March 13, 1901, namely, Rendrock and picric acid have been provisionallly adopted for charging 1000 shell for trial in service. But later successful efforts to detonate explosive D in the field shell render it probable that this explosive may be substituted for one or both of those previously mentioned. The trial lot of 3.2-inch shell to be used in determining this have not yet been received at the proving ground. Continued trials of explosive D and maximite in the Gathmann competitive test have confirmed the very successful use of these explosives as finally recommended in the board's report of May 25, 1901. These explosives are to be used in all calibers of steel shell from 4 inches upward for siege and seacoast service. Seventy-five thousand pounds of maximite have been purchased. Plans have been devised for plants to be used in loading these explosives, which are to be put in operation at the powder depot.

"The question whether the plant for the manufacture of picric acid should be erected and maintained by the government or whether the material should be procured from private manufacturers in this country was decided in favor of the latter plan. Specifications governing the manufacture and inspection of picric acid and other explosive materials were prepared and forwarded. Minor amendments to these specifications were forwarded under date of November 8-27, 1901."

FUZES IN U. S. ARMY: TESTS, ETC.—The following notes appear in the special bimonthly report of the ordnance board of the U. S. Army, dated January 1, 1902:

"The determination of a series of tests of the Frankford Arsenal base percussion fuze was reported January 9, 1902. The principal change from former patterns relates to the plunger. A centrifugal acting plunger, designed by Captain Dunn of the ordnance department, has been substituted for the ring resistance plunger. The plungers of 7-inch and 12-inch mortar fuzes are arranged for side impact action. A special delay-action cap is used to give a delay of 0.02 of a second.

"The Merriam base percussion fuzes now under trial is made dependent upon centrifugal action and the trials have not yet been concluded.

"The Frankford Arsenal 15-second combination time fuzes when fired from the 15-pounder R. F. gun, with velocity of 2600 f. s. the service fuze was found to be extinguished in flight. Trials showed that this occurred at velocities above 2200 f. s. The holes in the cone cover were closed and vents made near the top of the cover, protected by a hood. The extinguishment of the fuze was obviated. Trials are in progress to determine the proper area of ventage to give uniformity of burning in flight.

"The 20-second combination time and percussion fuze is a new design of a fuze prepared by Captain Dunn of the ordnance department in which, while retaining the lead-drawn time train, arrangement is made for igniting the train from the interior and enabling the fuze to be set or reset for any desired time of flight, thus avoiding the defect of the existing pattern, in which, if a fuze has been once cut, it can not afterwards be used for any longer time of flight. The test of the new fuze is still in the preliminary stage.

"In the Stevens' time fuze attempt was made to produce a time fuze to be used in the base of projectiles. The joints made necessary for setting the fuze render it dangerous. The majority of the fuzes exploded in the bore of the gun.

"The matter of the detonating fuzes for high explosive projectiles was fully treated in the board's report of December 23, 1901. The detonating fuzes used in the extensive trials of high explosive shell already successfully prosecuted have been prepared by utilizing the Pierce siege fuze stocks on hand. The manufacture of about 14,000 or more detonating fuzes of this pattern has been recommended. A more compact form of fuze designed particularly for armor-piercing projectiles is designed for future construction. Patterns are being prepared for test. The detonating fuzes for field and siege projectiles will be made for point insertion. Those for armor-piercing projectiles will be made for base insertion. Wherever base detonating fuzes are used the base of the projectile will be covered with a substantial copper cup to exclude the entrance of the powder gases through any joints in the base of the projectile."

BASE AND HEAD CHARGES FOR SHRAPNEL: TRIALS OF NEW U. S. ARMY SHRAPNEL.—The ordnance board of the Army, in its special bimonthly report, dated January 1, 1902, says:

"The new design of 3-inch shrapnel for 3-inch B. L. rifle embodies a bursting charge in the base which increases the velocity of the balls on dispersion from 200 to 250 f. s. over that derived from the head charge. A special feature of the new shrapnel relates to the base charge, which is composed of compressed mealed powder, upon which rests the diaphragm and column of shrapnel balls."

ARMOR.

DAVIS PROCESS FOR CEMENTING IRON OR STEEL.—"A patent was issued by the United States Patent Office on November 26 to Lieutenant Cleland Davis, U. S. Navy, for a process of cementing iron or steel. The process is for carburizing steel or iron plate by intensely heating

one side of the plate by means of an electric current passing through that face of the plate from a carbon conductor, and during the operation screening the conductor and the part of the plate under treatment from air, and simultaneously maintaining at a lower temperature the opposite side of the plate."—*Army and Navy Register*, November 30, 1901.

GIEBELER STEEL.—"The *Armeeblatt* of November 27 says that experiments were recently made at the technical school of Charlottenburg with a special steel produced by a new process and that the results obtained are likely to cause a revolution in industrial metallurgy. The inventor, Herr Giebeler, possesses small works at Mecklenburg. He has for some time been using his new process and now, as a result of the favorable judgment of the Charlottenburg tests, is desirous of bringing a knowledge of it to public notice. With the Giebeler process it has been found possible to give to any quality of iron a hardness and resisting power double that obtained by the Harvey, Krupp, or Scholler methods. Moreover, the cost of the Giebeler steel that is thus obtained is less by 50 per cent than that of steel produced by the other methods mentioned. A 7¾-millimeter (.305-inch) plate was fired at with small projectiles which left an imprint only 1 millimeter (?) deep, while a Krupp plate 11¾-millimeters (.46-inch) was completely perforated; and plates of ordinary steel when struck by similar plates of the new metal are said to have been broken into splinters. A representative of Herr Giebeler has been sent to Pittsburg to place the invention with the great American Steel Trust. The author of the article in the Austrian periodical says that although the information respecting the tests proceeds from a reliable source, yet it is impossible to accept the reports without reservation; and thus it also appears to us."—*Rivista di Artiglieria e Genio*, December, 1901.

KRUPP 5.9-INCH NICKEL-STEEL FACE-HARDENED PLATE: TRIAL.—"The trial of a 5.9-inch Krupp nickel-steel face-hardened plate recently took place at Krupp's proving ground at Meppen. It was the representative plate of a lot of armor for the Netherlands coast defence ship De Ruyter, 4950 tons, and was 6.9 feet wide and 10.8 feet long. The projectile used was Krupp's 5.9-inch armor-piercing shell weighing 100 pounds (45.5 kilograms). The conditions of acceptance required that the plate should not be perforated or cracked by three shots fired at a velocity of 565 meters (1854 feet) per second. The points of impact were the vertices of an equilateral triangle of 550 millimeters (21.65 inches) length of side, and so disposed that no one of the points should be less than 550 millimeters from the nearest edge of the plate. The trial was highly satisfactory and the plate more than satisfied all requirements. They then increased the velocities from 565 meters to 680, 701, and 720 meters (2230, 2300, and 2362 feet). Complete perforation without fracture was attained at the last shot; in the preceding ones the rear bulge was broken out but the projectiles did not get through."—*Rivista Marittima*, January, 1902.

V-SHAPED GUN SHIELDS.—"Two new gun-shields made by the Bethlehem Steel Company were recently tested. They are V-shaped and have an inclined surface of 3 inches of Kruppized face-hardened armor; the gun projects through the center of the point. Each shield is 48

inches high and 78 inches long. At these targets 3-inch guns were fired at 1000 yards range and 5-inch guns at 1500 yards range. The trials are reported to have been successful."—*Engineer* (London), February 14, 1902.

TRIALS OF 2-INCH AND 4-INCH PLATES.—"A 2-in. armor-plate, of the type used in ironclads and armored cruisers for continuing the armor from the belt to the ram, manufactured by Messrs. Cammell & Co., of Sheffield (who are making the whole of the armor for the Queen, about to be launched at Devonport), was tried at Whale Island, Portsmouth, on Friday. Three rounds from a 6-pounder quick-firing gun were fired at velocities averaging 1700 foot-seconds, and the shots splashed, but there was no penetration. Then one round from a 4-in. quick-firing gun was fired, with a velocity of 1650 foot-seconds; and here as in the previous test, there was no penetration, nor cracking, but a slight bulging of the plate. On Saturday, a 4-in. plate, manufactured by Messrs. W. Beardmore and Co., of Glasgow, was tested at Whale Island, and three rounds were fired from a 4.7-in. gun. A similar test was carried out on the previous day; but in both cases the projectile splashed on the plate without cracking or penetrating."—*Engineering* (London), January 24, 1902.

ARMOR-PLATE MILL: TRIAL.—"The armor-plate mill built by Davy Brothers, of Sheffield, for Armstrong, Whitworth and Co., and erected at their Openshaw works, underwent a successful trial last Friday afternoon. A steel slab, 15 inches thick, and weighing 20 tons, was put in the mill, and was rolled down to a plate 4 inches thick, in 9½ minutes. The new plant is unusually powerful, and the time occupied in rolling is very much reduced."—*Engineer* (London), December 6, 1901.

COALING SHIP.

COALING AT SEA WITH TEMPERLEY-MILLER APPARATUS.—"Last week the Temperley-Miller apparatus for coaling ships at sea under weigh was tried in Portsmouth Harbor with the vessels stationary. A rate of 37 tons an hour was reached. Various naval wiseacres of the non-progressive order spent the rest of the week in demonstrating that this could not be done at sea. On Monday there was a proper sea trial, and 36 tons an hour was reached—practically the same as the harbor result, and one that practice—if past coaling experiences go for anything—will double. However, this matter is too important to be dealt with in a paragraph, and we shall later on be dealing with it elsewhere in detail. On Wednesday, the 5th, at the official trials, 30 tons were taken for three hours' running, and 40 tons taken one hour. Everything was a complete success."—*Engineer* (London), February 7, 1902.

"The line-of-battle ship Trafalgar and the collier Muriel put into Portsmouth on Thursday, having completed a series of official trials undertaken to test the utility of the Temperley-Miller marine cableway for coaling ships at sea. Working under contract conditions, the apparatus placed an average of 30 tons of coal per hour on board the Trafalgar, while that vessel was steaming at 10 knots. At a slower speed, and with the cableway shortened, 40 tons per hour were transhipped. The Admir-

alty officials who witnessed the trials were so well satisfied with them that the cableway is to be given a trial with the Fleet."—*Engineering* (London), February 14, 1902.

COALING PLANT AT PUGET SOUND NAVY YARD.—"Plans have been completed for a coaling plant at the Puget Sound Navy Yard, the estimated cost of which is about $300,000. The bureau of yards and docks has at present available for the work a total of $128,000 and it is proposed to enter into a contract for the construction of a coaling shed and appliances to cost about $112,500 and for dredging to cost $15,500. The plans have been drawn so that the plant may easily and economically be extended as regards capacity. There will be two coaling sheds and a 650-foot wharf. The coal handling machinery will be of the highest grade and the unloading capacity of the tower will be at least 60 tons per hour. The cable road equipment for transferring coal from the shed to the wharf will operate at the rate of 200 tons per hour."—*Army and Navy Register*, January 11, 1902.

COALING PLANT AT SAN JUAN NAVAL STATION.—"Plans have been completed for the construction of two coal hoisting towers at the naval station at San Juan. This construction is to be part of the coaling facilities at that place and the contract to be awarded by the Navy Department will include the machinery. The department has $20,000 available for this purpose. The towers are to be of the Boston type so far as this type is understood to define a tower in which one engine or drum is used for hoisting and another drum is used to give horizontal motion to the hoisting rope or chain from a position over the ship's hatch to a position over the cars or hopper. The towers are to be movable and to be erected upon a trestle and track to be furnished by the government. The gauge of track will be made to accommodate the towers, which are to be designed to use a gauge of 29 or 30 feet or between these limits. The wheel base is not to exceed 26 feet. Nine wheels are to be used and the loads distributed as uniformly as possible. Sufficient devices to secure the towers to the tracks under working and wind conditions are to be furnished by the contractor."—*Army and Navy Register*, November 30, 1901.

GUNPOWDER AND EXPLOSIVES.

U. S. NAVY SMOKELESS POWDER: CORRECTION OF PREVIOUS NOTE—In a note in PROCEEDINGS No. 100 (page 803) on "Navy Smokeless Powder," the following statement is made: "The explosion at Indian Head was probably caused by the decomposition of some powder made when the process of manufacture was just begun there and of much inferior quality to that now produced." This statement was derived from what purported to be a brief of the report of the Chief of Bureau of Ordnance appearing in a service periodical (the official report not then being printed). It is nevertheless an error. Lieutenant Strauss, inspector of ordnance in charge of Indian Head Proving Ground, informs me that not a pound of Navy smokeless powder manufactured at Indian Head was in the storehouse that exploded. Considerable old navy smokeless powder made at private works was in the building in addition to

other powders, but none which was made at Indian Head. The explosions at the proving ground and at Mare Island were disquieting and it is very reassuring to find that neither of them was due to powder manufactured at Indian Head and quite possibly not even to decomposition of early samples of navy smokeless powder produced in private factories, but to other causes.

CORDITE: ITS USE IN BRITISH NAVY TO BE DISCONTINUED.—There is now no doubt that the use of cordite in the British navy is to be abandoned as soon as practicable. It seems strange that so defective a powder should so long have been retained in use. Its erosive action was a bar to high velocities; variations of temperature caused serious variations in velocity; and a temperature which was not higher than might be occasionally expected caused exudation of the glycerin, making the powder dangerous to handle or to use in guns. These defects are common to all powders containing nitroglycerin, though when the percentage of it is low, only erosion is particularly noticeable and that is much reduced. No definite details of the new explosive have been published. Its name is said to be "cordite M. D.," and it is generally referred to as the "improved cordite." This leads to the supposition that the form remains unchanged though both theory and experiment indicate that a multi-perforated or specially shaped grain gives better results than a cord, the burning surface of the latter decreasing in area instead of increasing as combustion proceeds, the pressure falling rapidly. As bearing on this point compare the pressure curves given in PROCEEDINGS No. 100, pages 808 to 813. These curves are not very accurately drawn but they are approximately correct and show the value of the multi-perforated grain of the nitrocellulose powder. See also PROCEEDINGS No. 100, pages 804, 805, 806. The great defect of nitrocellulose powder grains is their brittleness after long stowage but this is in a fair way of being remedied. As regards the erosion of guns by cordite and other powders, see PROCEEDINGS No. 97, page 198, and No. 98, page 418. In some of the notes on the new British powder which have appeared it is stated that the charges of the new cordite for 4.7-inch guns will be 5 lbs. 7 oz.; for 12-pounder guns, 1 lb. 10 oz.; for 6-pounders, 7¾ oz.; 3-pounders, 6⅔ oz.; and the .303 service rifle, 30 grains. This is the same as the present cordite charges in the 4.7-inch gun and 6-pounder; it is 5 oz. *less* than the present charge of the 12-pounder, and $\frac{7}{16}$ oz. more than the present charge of the 3-pounder. If the figures reported are correct the new cordite does not differ much from the old, or else a sacrifice of velocity has been made; possibly the powder chambers of the guns now in service are too small to use adequate charges of the new powder.

SMOKELESS POWDER IN MORTARS.—"General Crozier, chief of ordnance of the Army, has authorized some important investigations to be made into the character of smokeless powder used in the 12-inch breech-loading mortars. The report of the mortar test held at Fort Preble, Me., disclosed certain irregularities of range with the smaller charges of smokeless powder used in those tests. The investigations now instituted by General Crozier will be made with the object of determining whether a smokeless powder of uniform grain can be used for all charges in the 12-inch mortar or whether a smaller grain must be used for the small

charges. It is intended that in the coming tests the projectiles will be of nearly uniform weight of metal to avoid any effect on the range that may be produced by firing projectiles with the cavity only partially filled. In this connection it is proposed to make tests to determine a scale of velocity for smokeless powders depending upon the temperature of the powder charge. This will require the erection at Sandy Hook of a refrigerating chamber where the charges of powder will be exposed before firing to temperatures varying from 10 degrees below zero to 130 degrees above. The same investigations will be made of smokeless powders for other calibres of cannon generally, in expectation of some interesting and important results."—*Army and Navy Register*, February 15, 1902.

MAXIMITE: REMARKS.—"Our ordnance officers appear to have formed a very favorable opinion of maximite, to which the last *Journal of the Military Service Institution* devotes several pages, with the unusual accompaniment for that staid periodical of a portrait of the author. Mr. Maxim appears to have obtained remarkable success in uniting insensitiveness with high specific gravity and immense explosive force per unit of volume. Maximite cannot be exploded by ignition or shock, and when heated in an open vessel it will evaporate like water, so that the temperature cannot mount to the explosive point. The shells are filled by pouring the melted explosive into them. Its expansion, while solidifying into a dense and solid mass, packs it so hard as to prevent the formation of air spaces. The terrific force of the exploding charge is shown by the regularity and rugged character of the 7000 fragments into which a 12-in. forged shell, weighing 1000 pounds, has been blown. So far as experimented with maximite appears to have excellent chemical stability, or keeping qualities. Shells loaded with it have been fired through armor plates from three to twelve inches thick, and either exploded in the plate or just beyond it, showing that it will stand the shock of going through any armor plate that shells loaded with it will penetrate. The fuse used in the experiments with maximite is the secret invention of Captain Dunn of Frankford Arsenal. When relieved of its striker it has been fired through the heaviest plate without exploding. A shot goes through a plate in about the one-thousandth of a second. Mr. Maxim says in his article: 'So severe is the retardation on striking the plate that the fuse stock or steel tube which contains the fuse and extends forward into the chamber of the shell from the base plug has to be made exceedingly strong and of steel of the finest quality to prevent it from elongating or breaking off from the shock. The Frankford Arsenal detonating fuse stands this shock perfectly."—*Army and Navy Journal*, November 30, 1901.

GUANIDINE EXPLOSIVES.—The brief of the British patent (No. 12,617; accepted October 16, 1901) specifications of Sr. A. A. da Silva, Brazil, which appears in *Engineering* of December 6, is as follows: "According to this invention guanidine is used in explosives and is combined with such acid or oxygen-containing substances as are otherwise used in the manufacture of such materials. One such explosive, picrate of guanidine ($C_6H_2OH(NO_2)_3CN_3H_5$) is obtained in the form of small crystals or of very fine yellow powder which is almost insoluble, and the preparation of which, it is stated, is not attended with danger, whilst the result-

ing compound is stable, easy to keep, burns slowly in the air, is not exploded by shock, and has the remarkable property of being capable of association with saline combustives (nitrates, chlorates, etc.) without danger of reaction between the ingredients, 'the mixture preserving an absolute insensibility to shock in the case of nitrates.' By the combination of guanidine with nitric acid, nitrate of guanidine ($CN_3H_6NO_3$) a crystalline, flexible, stable, nondeliquescent, and neutral safety explosive is obtained, which, when heated in an open vessel, melts first and afterwards burns briskly without smoke or residue and with no production of corrosive or irritant gases. This product being soluble in 'alcohol etherized with common ether or with acetic ether,' can be intimately mixed with the nitrocelluloses, the combination of which it retards and which by it are rendered insensible to mechanical shock whilst retaining their sensitiveness to detonation."

DETONATING COMPOSITION TO REPLACE FULMINATE OF MERCURY.—This composition is the invention of Herr J. Fuhrer of Vienna, and it is intended for use in place of fulminate of mercury for producing the initial detonation necessary for firing a charge of high explosive. It is very much safer to handle than fulminate of mercury and the inventor claims it will satisfactorily detonate the high explosives. If so, the gain will be very great. One of the great dangers in handling high explosives has been the sensitiveness of the fulminate fuze or detonator, and no satisfactory detonator not containing fulminate of mercury has (unless this proves to be the long sought article) been obtained. The materials used are copper, ammonium nitrate, potassium nitrate, sulphur and aluminum. One formula specifies 30 to 40 parts of copper-ammonium nitrate, 42 to 25 parts of nitrate of potassium, 10 to 7 parts of sulphur, and 18 to 28 parts of metallic aluminum. The date of acceptance of the British patent (No. 20,755) is December 31, 1901.

AMMONAL: COMPOSITION, REMARKS, TESTS.—"Ammonal is the name of a new high explosive, claimed to be powerful in its effect and safe in use. The explosive contains no nitrified substance, but is a mechanical mixture of nitrate of ammonia and aluminum. It is less liable to absorb moisture than other powders of its class and keeps well when properly packed.

"The explosive is not only a blasting compound for industrial and mining purposes, but also a military high explosive of rare excellence. When used either in mines or in ordnance, both safety and enormous power are obtained. So far as its industrial use is concerned, the most striking feature of the explosive is the total absence of noxious gases, for which reason it is most fit for blasting in pits and quarries.

"Picric acid and wet guncotton, explosives most commonly used in shells and torpedoes, require a strong detonator (about 2 grammes of fulminate) for thorough detonation. It is claimed that ammonal is the only high explosive which can be brought to complete detonation by a simple black powder priming, producing the same effect as if a fulminate cap had been used. But where a fulminate detonator is considered preferable to a black powder priming, as, for example, in torpedo charges or submarine mines, one gramme of fulminate is all that is required to detonate the charge.

"During the course of the year, a series of experiments were made before the officers of the Austrian navy, and before a foreign official (Capt. Tulloch of the Royal Artillery, England), in order to demonstrate the high efficiency of ammonal for military purposes. From 100 to 500 fragments were obtained by bursting a 12-centimeter steel service shell (1.21 kg.) with a bursting charge of 1300 grammes of ammonal. It must, however, be borne in mind that the absolute number of fragments obtained signifies nothing. If the proportions of the weight of the charge and weight of the projectile and the nature of the steel are unknown. Experiments made with 10.4 cm. howitzer shells (11.2 kg.) on the proving grounds of the Austrian Ordnance Board within the last two months, in order to ascertain what was the fragmentation in sand and the effect of the firing against earth cover, showed undoubtedly that ammonal is much stronger than the Austrian ecrasite, a picric acid compound.

"Steel shells were also fired from a 47 mm. Skoda rapid-fire gun against a 30 mm. steel plate, with a 60 grm. charge of ammonal and a small black powder priming. Perfect explosion was obtained behind the plate. There was no fuze in the shell, the black powder being exploded by the shock against the plate, and the fire transmitted to the ammonal and retarded."—*Scientific American.*

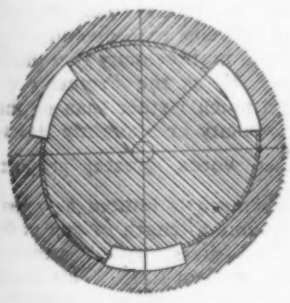
GUNS.

ADDITIONAL RESERVE GUNS FOR AUXILIARY CRUISERS.—Admiral O'Neill has asked for an appropriation of $250,000 to build additional reserve guns for auxiliary cruisers. The number now available is very small, as many of those which were made have been absorbed for training ships and auxiliary cruisers purchased and retained in service. There are now under contract seventy-two guns, or enough to arm eight or ten vessels only, and a number should be built each year until the proper reserve supply is reached.

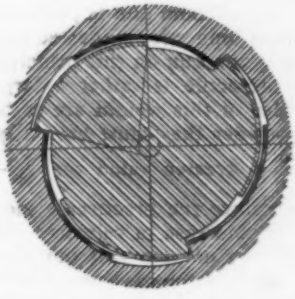
RESERVE GUNS FOR SHIPS OF THE REGULAR SERVICE.—"Secretary Long has approved the recommendation of the chief of ordnance of the Navy for the construction of reserve guns for ships of the regular service. It is proposed to manufacture five 5-inch guns, six 6-inch guns, six 8-inch guns, four 12-inch guns and four 13-inch guns. The cost of this will be $499,300. It may be regarded as a certainty that the rifling of guns will in course of time wear out, rendering it necessary to insert a lining tube in them, and that accidents will from time to time occur to guns in service which will necessitate their removal from ships for purposes of repair. In either case vessels must be laid up while such repairs are being made, or must go without a part of their armament, neither of which seems to be advisable. It is therefore recommended that a few spare guns be procured to be held in reserve. Moreover, one or more guns of each caliber are always required at the proving ground for making tests of armor, of powder and projectiles."—*Army and Navy Register*, February 1, 1902.

MEIGS-HAMMAR BREECH MECHANISM.—The peculiar features of this mechanism are in the breech plug and plug chamber. At first glance it

appears to resemble the Welin breech but a close examination shows this resemblance to be only apparent. The breech and plug are divided into two or more divisions, radially. Each division, in turn, consists of a blank and a threaded portion. The blank portion is cylindrical but the threaded portions are involutes of circles, so that the threads of the breech and of the block are equidistant along all radii at any position of the plug, open or locked. This insures an even and excellent contact. As at present built the threads have no pitch. A point of particular importance, as affecting the ease of opening, is that the threads begin to disengage as soon as they start to revolve, and this disengagement, slight at first, is sufficient to make it very easy to open the breech of a gun of the largest size. For convenience of withdrawal the plug is slightly coned. This is the invention of Mr. John F. Meigs (formerly of the U. S. Navy) and Mr. Sigard A. S. Hammar, ordnance engineers of the Bethlehem Steel Company, and it is used in guns built in the works of the Bethlehem Company.



Breech Closed.
Collars on block and gun engaged.



Breech Open.
Block free to swing.

BROWN WIRE-WOUND GUN: NEW JACKET.—The Brown 10-inch wire-wound gun, which failed in test at Sandy Hook through the giving way of the cast-steel jacket (see PROCEEDINGS No. 100, page 828), is to have a forged-steel jacket, which is now being made. When the repairs have been effected the gun will be fired again.

DAWSON-BUCKHAM BREECH MECHANISM.—This mechanism, which has recently been patented in England (British patent 13,337; accepted September 4, 1901) is a modification of the Welin-Vickers system and is patented by A. T. Dawson and G. T. Buckham of the Vickers Company. The circumference of the breech is divided into sectors as in the Welin system, but instead of having blank sectors equal in width to the threaded ones, they are of double width. This gives considerable clearance all around when the plug is wholly unlocked—sufficient to allow the plug to be turned out without first being drawn directly to the rear.

FORGINGS FOR GUNS FOR U. S. NAVY.—In November, the bureau of ordnance of the U. S. Navy awarded a contract for sixty sets of forgings for 3-inch field guns and fifteen sets of forgings for 4-inch 40-caliber guns for auxiliary cruisers to the Fore River Ship and Engine Company

of Quincy, Mass. The work on the forgings was begun at once, as the conditions of the contract required deliveries to begin in 50 days and completion of all forgings in 150 days. The *Army and Navy Register* says this marks the revival of gun-making in Massachusetts after an interval of about fifteen years, the last big gun being cast at the South Boston Iron Works in 1885, about which time, also, that establishment finished a contract for built-up steel guns for the navy. The Fore River Works are rapidly coming to the front as one of the great shipbuilding and engine works of the country, and the contract for gun steel signals their entry into another department of manufacture.

BIRKELAND ELECTRO-MAGNETIC GUN.—"An electro-magnetic gun, invented by Professor Birkeland, has been experimented with at Christiania. The shell is drawn out of the bore, and not, as hitherto, impelled by gunpowder, and the use of magnetism, according to the Professor, will enable 1000 lb. projectiles to be hurled much farther than by the present methods. This is a hard saying."—*Engineer*, London, February 14. The Birkeland gun is probably constructed on the solenoid principle, which was long ago suggested for giving velocity to projectiles, but the operation of a gun on this principle to give a high velocity to a thousand-pound projectile is rather a large order. If, as the Professor claims, projectiles of this weight are to be hurled much farther than by the use of gunpowder they must have a greater velocity or a slightly less velocity and a greater value for $\frac{w}{d^3}$—in other words, greater proportional length. Since the practicable increase of length is limited he must rely chiefly on increase in velocity. Let us assume a length of gun of 60 feet and velocity of 3000 feet per second. This gives, with a projectile of 1000 pounds, a muzzle energy of about 63,000 foot-tons. This enormous energy must be developed in a very small fraction of a second. The initial velocity of the projectile is zero and its muzzle velocity is 3000 feet; its mean velocity in the gun is therefore 1500 feet, and it therefore requires .04 second to travel the length of the bore. The unknown electrical force acts .04 second, producing 63,000 foot-tons of work. In one minute it would therefore produce 94,500,000 foot-tons or about 6,300,000 horsepower. This seems a good deal of power to put in dynamos. If the gun tube were twice as long only about half as much power would be required. No question of efficiency of the solenoid, dynamos, steam machinery, etc., is here considered.

GUNS: FIRING.

NOTE.—Under this head will be given notes referring to firing tests of guns, target practice, special practice, accidents to guns while firing, etc.

BLOWING OFF OF MUZZLE OF 5-INCH GUN ON THE KEARSARGE.—One of the 5-inch guns of the battleship Kearsarge blew off about five feet of the muzzle end during target practice. The cause is ascribed to some defect in the metal of the gun. The conditions of firing, character of powder, appearance of fracture and the statement of eye-witnesses have not been published. No one was hurt and no damage done to the vessel.

GATHMANN GUN: REPORT OF JOINT ARMY AND NAVY BOARD.—The following is the report of the Board:

THE GATHMANN GUN TRIAL.

New York Arsenal, N. Y., Nov. 29, 1901.

The Chief of Ordnance, U. S. A.:

Sir: The act of Congress (Public No. 113) approved March 1, 1901, appropriated $50,550.00 to enable the Secretary of War to make comparative tests of the destructive energy between the Gathmann torpedo gun, now at Sandy Hook, N. J., and the 12-in. Army Service rifle, such tests to be made against two similar targets representing the side construction of the latest type of battleship, each of said structures to be faced with the Kruppized armor plate, 8 feet by 16 feet and 12 in. thick, and at least ten shots to be fired from the Army rifle against one structure and one or more from the Gathmann torpedo gun against the other. This test was conducted by a Joint Board of Officers of the Army and Navy appointed by special order No. 252, dated Headquarters of the Army, Adjutant General's Office, Washington, Oct. 26, 1901.

The targets were constructed by the Navy Department; the plates were 16 feet long by 7½ feet wide, and 11½ inches thick. They each weighed 47,000 pounds.

The target structures were similar in all respects, and each actually represented a section of the side of the latest type of battleship, but the structures themselves lacked the support of the adjacent armor plates and of the surrounding frames, beams and decks that make up the whole structure of the ship, it being impracticable to exactly simulate a battleship on so small a scale. It is considered, however, that the character of these experiments was sufficient from which to make conclusive deductions as to the effect upon a battleship when similarly attacked.

This test being for the purpose of comparing the destructive effect of two systems of attack, it will lead to a better understanding of the results to briefly describe the object of each system.

By the Gathmann system it was proposed to detonate a large quantity of guncotton against the side of an armored vessel without any attempt at penetrating the armor. It was claimed by the promoters of the system that the volume of gas produced by the explosion could be made to expend its force against the armor, and on the effect of this force the destructive energy of the system depended; it was claimed that a single shot would destroy a battleship.

The method used in the 12-in. Army Service rifle contemplated first, penetration of the armor, and then the detonation of a high explosive contained in a thick walled projectile. Thus there is involved the destruction of the armor, of the structure of the vessel, of the armament and interior mechanism and of the personnel.

Of necessity, the targets were set up on shore. It was impracticable to place the targets at distances from the guns of more than a few hundred feet, consequently it was necessary to use such firing charges as would give to the projectiles velocities on striking the plates such as they would have had if they had been fired with larger charges and at greater distances from the targets. Thus the firing of both guns was conducted at simulated ranges.

The Board accepted the recommendation of the Ordnance Board, U. S. A., as to details of projectiles and charges to be fired from the Army rifle, these details being based upon the use of the present type

of 12-in. gun, and without consideration of the greater power of the latest adopted type of this caliber.

The Board accepted the statements of representatives of the Gathmann Company as to the weight of charge to produce the desired striking velocity. The simulated ranges as given, however, are computed from the actual results obtained from firing, in the third round, a full charge of powder as designated by the Gathmann Company. The company protested against firing shots at either target at simulated ranges less than 7000 yards, but the Board over-ruled this protest, it being considered that such a test would not give conclusive results as to the comparative destructive effect of the two weapons. This action was not considered unfavorable to the claims of the Gathmann system, since in a written communication from the company its President stated that:

"Even should the range of 7000 yards be deemed extreme, it cannot be disputed that a weapon effective at that range would be more so at a shorter one."

Representatives of the Gathmann Company were consulted before each round as to the details of loading and firing, and in each case expressed themselves as being satisfied with the conditions.

THE GATHMANN TEST.

Round One.—A Gathmann projectile weighing 1834 pounds, including 497 pounds of wet guncotton, struck the center of the plate at a velocity of 1650 foot seconds, corresponding to a range of 2709 yards. The energy of impact due to the mass of the projectile was 34,610 foot tons. The guncotton in the shell detonated on striking the plate. The plate was dished in the center 1½ inches on its major axis, and ½ inch on its minor axis, and was slightly flaked at the point of impact. In other respects the plate was uninjured. The tap bolts securing the top plate of the armor were sheared; the bracket plates of the cellular structure in the rear of the frames were buckled about four inches; a 3-in. plate which had rested, unsecured, on wooden sleepers in the sand, in front of the plate, was moved away and the edge next the plate was pushed downward nine inches into the sand. The backing the frames behind the armor and the wooden uprights against which the whole rested were practically uninjured, save for the shearing of a few rivets. Had this projectile struck the belt armor of a battleship, which the target represented, it would not have endangered the vessel.

Round Two.—A Gathmann projectile weighing 1839 pounds, including 507 pounds of wet guncotton struck the right center of the plate with a velocity of 1,650 foot seconds, corresponding to a range of 2709 yards. The energy of impact was 34,700 foot tons. The gun cotton in the shell detonated on striking the plate. The effect of this impact on the plate and on the structure behind the plate was similar to that of the preceding round. The plate, the backing, the frames behind the armor and the wooden supports against which the whole structure rested, remained practically uninjured. The bracket plates forming the sides of the coffer-dam behind the framing were still further buckled, allowing the right hand edge of the plate to be moved two feet nine inches to the rear; the left hand edge was sprung back to its original line. The whole structure was moved 13 inches to the right. The plate being practically uninjured, it is obvious that no harm could have come to the personnel, armament

or the interior mechanism of a vessel. It being evident also that neither of these rounds would have so far injured the structure of a ship as to endanger its buoyancy, it was decided to fire a third shot at a maximum velocity and point blank range in order to determine if it were possible to inflict any damage whatever upon the plate by this system of attack.

Third Round.—A Gathmann projectile weighing 1840 pounds, including 514 pounds of wet guncotton, struck the center of the plate with a velocity of 1970 foot seconds, corresponding to point blank range. The striking energy was 49,500 foot tons. As the result of this impact there was a vertical through crack eight feet distant from this point of impact extending through a row of bolt holes and through the place struck in the preceding round. In other respects the effect on the plate was as in the former rounds.

The backing, the skin plates behind the backing and the wooden supports against which the structure rested were slightly displaced. The left hand edge of the plate was thrown backward about 15 inches under the top plate; the bottom left hand side of the plate was shoved back four feet. The whole structure, including the wooden supports against which the section rested, was revolved to the left about 30 degrees. The top layer of deck plating was detached and thrown to the rear on top of the sand butt about ten feet. The metal structure behind the armor on left side of the target collapsed.

It is evident that, had this shot struck the belt armor of a battleship, it would have resulted in no injury to the interior mechanism, the armament or the personnel of the vessel, and would not have seriously menaced its buoyancy. While the target structure was very much damaged by the accumulated effect of the pounding resulting from these three shots striking with a total energy of 119,000 foot tons, neither shot in itself would have endangered the buoyancy of a battleship or have wrought serious local damage.

With the idea of determining whether the effect on the target of the impacts of the three preceding rounds was due to the detonation of the guncotton or to the striking energy of the mass of the projectile, it was suggested by the Gathmann Company that the fourth empty shell be filled with sand and fired at the target. An examination of the target, however, showed that the true effect of the energy of such an impact could not be obtained, owing to the then condition of the target. A just comparison between projectiles loaded one with guncotton, the other with sand, could only be made by firing each at new and like targets.

12-IN. ARMY SERVICE RIFLE.

Round One.—An armor-piercing shot weighing 1001 pounds and 7 ounces, including 19 pounds 7 ounces of Army high explosive, struck the center of the target with a velocity of 1800 foot seconds, corresponding to a range of 4400 yards. The striking energy was 22,500 foot tons. This shot penetrated the plate and was detonated just in the rear. The backing, the skin plates, frames and cofferdam plates were completely demolished in the line of this impact. The crater formed in the sand butt in the rear of the structure measured 15 feet by 6½ feet. Pieces of the plate and projectile passed through the structure, through the butt and were recovered at distances of 150 to 200 feet in rear of the butt. The rivets in the top plate were sheared, the side plates of the cofferdam

were buckled about three inches and the plate was forced back bodily about ¾ of an inch. It is evident that had this shot struck a battleship it would have wrought serious damage to the vessel.

Round Two.—An Army 12-in. armor-piercing shot weighing 1006 pounds, including 23 pounds of Maximite, struck the right center of the plate with a velocity of 1804 foot seconds, corresponding to a range of 4400 yards. The striking energy was 22,500 foot tons. The shot detonated in the plate, completely wrecking the right hand portion and demolishing the frames behind the armor and the plates of the cofferdam. It is evident that had this shot struck a battleship it would have wrought serious injury to the vessel.

Round Three.—A 12-in. armor-piercing shell weighing 1045 pounds, including 60 pounds of Army high explosive, struck the lower left hand center of the plate with a velocity of 2073 foot seconds, corresponding to a range of 1880 yards. The striking energy was 31,100 foot tons. The shell penetrated and detonated in the plate. As a result of this impact the plate was totally wrecked, and the backing, frames, beams, and cofferdam plates of the structure were completely demolished. An opening was made through the plate 4 feet wide by 8 feet long.

The lower left hand quarter of the armor plate was broken into six large fragments and numerous small ones, the largest being about 4½ feet square, which, with the backing and skin plates, was torn loose from the structure and turned inwards so that the left hand edge of this fragment was in the plane of the original face of the plate. One large fragment about 2 feet by 2½ feet by 11½ inches and weighing about 2500 pounds, was hurled through the target, through the butt and was recovered 135 feet in the rear of the butt. Numerous fragments of the plate and projectile passed through the target structure, through the butt and were recovered in the rear. The effect of this shot would have resulted in serious injury to a battleship.

The act of Congress required that at least ten shots should be fired from the Army rifle against one structure, but the annihilation of the structure by the three rounds made it impracticable to comply with this mandate.

The results of these experiments give a fair illustration of the effect that can be produced by each system. The separate effect of each round and the accumulated effect of the three rounds from the Army Service rifle was, in each and every instance, superior to that from the Gathmann gun.

After a careful consideration of the effect of the various impacts on the respective targets of the Gathmann gun and the 12-in. Army Service rifle, the Board finds that none of the impacts from the Gathmann gun would have endangered a modern battleship; that the Gathmann system is not effective as a means of attacking armored vessels; and that any one of the shots from the 12-in. Army Service rifle would have wrought serious injury to a modern battleship as regards its buoyancy, the interior mechanism, the armament and the personnel.

It may be said in this connection that the destructive effect of the 12-in. Army Service rifle surpasses anything hitherto obtained from any gun as far as this Board has knowledge, or as the records show.

In considering the value of the two guns, not only must the destructive energy be taken into account, but their respective merits with refer-

ence to range and accuracy. From the experiments just completed, it is found that the 18-in. gun which fires the Gathmann projectile, has a velocity of less than 2000 foot seconds. The Army 12-in. rifle which was used in this test has a velocity of 2300 foot seconds, and the latest type adopted by the War Department has a muzzle velocity of 2650 foot seconds. Both in initial and sustained velocities, the 12-in. Army Service rifle of both models is so far superior as to give at all ranges a very much greater probability of hitting, and the remaining velocity at four miles is sufficient to perforate the heaviest armor now being put on battleships.

There is nothing in the Gathmann system to recommend its adoption in the public service of the United States, or to warrant further experiments.

Photographs of the guns and targets and showing the effects of the various rounds, together with the detailed records of firing and of the results of the impacts, are appended to this report.

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COLT GUN: EXPLOSION OF SHELL WITH BREECH OPEN.—"By an explosion of a Colt's automatic firing gun at Fort Leavenworth, Oct. 28, Capt. Charles T. Menoher and five men of the 28th Battery, Field Artillery, were wounded, three severely. The gun, a new one being tested, became too hot, and when a shell came into the breech, after firing, it exploded, tearing out the breech, fragments of which struck and injured the men. Captain Menoher's hand was burned and his wrist injured."—*Army and Navy Journal*, November 2, 1901.

TESTS OF MORTARS AT PORTLAND.—The report of the board which conducted these tests has not been made public and it is doubtful if it will be—at least at present. According to statements in the public press there were some developments that it is thought desirable to keep secret. The following appeared in the *Army and Navy Register* of November 30: "It will be a week or ten days probably before the War Department receives the report of the mortar tests which have been conducted at Fort Preble, Me. Colonel J. R. Myrick and Captains J. B. Bailey and Frank S. Harlow, of the artillery corps, are engaged in the preparation of the report. In general terms those officers willl announce the success of the mortar as a feature of the armament of coast fortifications. The report, however, will not be laudatory to the extent of a denial of any faults which have been found to exist in that form of defense. One of the defects which it is said has been manifest at Fort Preble arises from the fact that mortar batteries are placed in deep pits, sometimes forty feet below the surface of the ground, necessitating a high angle of fire in order to have the projectile clear the works. It is now realized that the accuracy of mortar fire would be greater if the battery were placed on the surface of the ground and not in a sunken emplacement. The report from the Myrick board is bound to be most interesting since it relates to the first practical test we have had with

mortars. It will be correspondingly illluminating and it ought to be convincing, one way or the other, to those who have been discussing the mooted question of the value or usefulness of mortars."

BELLEISLE EXPERIMENTS: SECOND SERIES.—"The Belleisle, hulk, which has been specially fitted up for experiments, was on Tuesday fired into off Bembridge, Isle of Wight, by the gunboats Pincher, mounting a 9.2-in. gun, and the Comet, armed with a 6-in. gun. A 20-ft. section of the Belleisle on each bow had been fitted with a type of plate manufactured by Messrs. Cammell and Co., of Sheffield, the principal feature of the plate being that it was only partially Krupped, in order to ascertain the elasticity and resistance of a plate made under these conditions. In thickness, the 6-in. plate on the starboard side of the Belleisle represented the armor of the Drake class of cruiser, and the 4-in. plate on the port side the armor of the "county" class. Internally, the ship in the armored section was fitted with bunkers, transverse bulkheads, and other supports such as would be found in the armored area of seagoing ships. The new form of lyddite, as well as armor-piercing projectile, and common shell, were used, and the utmost precautions were taken to police the vicinity, both ashore and afloat, in order to prevent unauthorized persons from coming within a clear view of the operations. In all ten rounds were fired, the 6-in. plate being first attacked. Two rounds were fired from the 6-in. gun, followed by two rounds from the more powerful weapon, and after each pair of rounds the ship was visited by the Lords of the Admiralty, and photographs were taken. The Belleisle was moored broadside on to the shore, and after the thicker plate had been tried the ship was turned roun l, and the port side was fired into, when again both guns were used. As far as could be seen from the shore, the concussion at each round was so great as to cause considerable débris, and ultimately it looked as though the 9.2-in. gun had penetrated the 4-in. plate, as the vessel appeared to be sinking. She was drawing 15 ft., and had only 16 ft. of water under her; so that when a party of bluejackets had gone on board and patched up the leaks, it was found possible, with the extra provision of collision mats, to tow her back to Portsmouth."—*Engineering*, London, February 21, 1902.

The range is said to have been about 1200 yards.

TARGET PRACTICE IN BRITISH NAVY: ANNUAL REPORT.—"The return of the annual prize firing with heavy guns in the vessels of the Channel Squadron has just been published. In the case of the 13.5-in. gun two runs of six minutes for each gun were made, but for the 12-in. guns one run of six minutes was made for each gun. The results were as follows:

Ship.	Gun.	No. of Gun.	Rounds.	Hits.
Repulse	13.5-in.	4	25	10
Resolution	13.5-in.	4	28	9
Mars	12-in.	4	26	11
Majestic	12-in.	4	22	7
Magnificent	12-in	4	23	7
Prince George	12-in.	4	26	7
Hannibal	12-in.	4	22	6
Jupiter	12-in.	4	20	6

"In the case of the 6-in. guns one run of two minutes was made, the result being:

Ship.	Gun.	No. of Gun.	Rounds.	Hits.
Mars	6-in.	12	112	62
Majestic	6-in.	12	123	52
Repulse	6-in.	10	77	39
Jupiter	6-in.	12	97	42
Resolution	6-in.	10	61	31
Hannibal	6-in.	12	84	35
Prince George	6-in.	12	96	34
Furious	4.7-in.	6	73	26
Arrogant	4.7-in.	6	63	19
Minerva	4.7-in.	6	68	18
Pactolus	4-in.	8	95	20 "

—*Army and Navy Gazette*, November 30, 1901.

IRRESISTIBLE: TRIALS OF GUNS AND MOUNTS.—The trials of the heavy guns of the British battleship Irresistible took place last autumn and were carried out under the supervision of Captain A. Barrow and the experimental staff of the gunnery ship Excellent. The following description is from the *Journal of the Royal United Service Institution:* "The usual number of rounds were fired from the forward turret with practice and service charges, and diagrams of pressure and velocity were taken from the recoil cylinders of both guns. These were in accordance with the design, the recoil being practically 33 inches with the full service charges. In the after turret an elaborate programme of speed firing was carried out to test fully, not only the new method of loading the guns at all firing angles, but the accuracy of fire obtainable under the new conditions. For this purpose a small target was launched overboard, and with the ship steaming at a distance of about 1200 yards, fire was opened with both guns, each of which fired five rounds alternately. The result was satisfactory, as every shot would have hit the side of a ship in the vital parts, while the ten rounds were fired off in 4 minutes 46 seconds. The crew had only had three days' practice with a type of machinery that was new to them, and it may therefore be reasonably assumed that even better results will be obtained with a practiced crew. After the trials the mountings were carefully examined and were found to be in good order, no hitches of any kind having occurred. Messrs. Vickers' Sons & Maxim have on order from the Admiralty similar sets of gun mountings for five other battleships, including the Vengeance, whose trials have since successfully taken place."

The mounts of the Irresistible are fully described under the head of "GUNS: MOUNTS."

GUNS: MOUNTS.

12-INCH TURRET MOUNTS OF THE IRRESISTIBLE: DESCRIPTION.—The first-class battleship Irresistible, 15,000 tons, has completed her gun trials with excellent results (see note under the head of GUNS: FIRING). The following description of the mounts for her 12-inch turret guns is derived from the *Journal of the Royal United Service Institution*, November,

1901: "The Irresistible was built at Chatham at an estimated cost of about £1,000,000 and her main armament consists of four 12-inch Vickers Mark IX guns, mounted in pairs forward and aft in armored redoubts. The revolving platform carrying the guns is protected by an armored steel hood 8 inches thick, but sloped to such an angle as to give the same protection as would be secured by armor of twice this thickness. Each 12-inch gun weighs slightly over 50 tons, and fires a projectile of 850 lbs. with a cordite charge of 207 lbs., giving a muzzle velocity of 2516 feet per second. The muzzle energy of the projectile is 37,810 foot-tons.

"The guns are mounted independently in pairs on a revolving platform, and can be manipulated by both hand and hydraulic power gear. The chief innovation in this gear is the introduction of a new feature of a comparatively simple nature which enables the gun to be loaded at any angle of elevation, thus obviating the necessity of bringing the gun to a fixed position for loading between the rounds, while, in accordance with the now universal practice in all new ships, the guns can be loaded in all positions of training. The adoption of the method of loading at any angle of elevation therefore completes the improvement which was begun when the fixed horizontal position for loading was abolished, so that now guns can be loaded in any firing position, thus avoiding not only the loss of time involved in bringing the weapon to and from a fixed position of elevation, but—what is of very great importance—the gunner is enabled to keep his sights constantly on the object he is aiming at. Thus the means are furnished both of rapid fire and accurate aim with the most formidable gun in existence.

"The redoubts of the Irresistible, which are circular, are protected by 12 inches of armor. The turn-tables revolve on a live roller ring carried on a ring bulkhead, supported independently of the redoubt structure, so that considerable distortion of the latter will not affect the working of the guns. A working chamber is attached to the underside of the turn-table, and revolves with it. From this chamber a trunk descends to the shell rooms and magazines, and serves for the passage of the ammunition from the latter to the chamber, where it is transferred automatically from cages in the trunk to cages working between the base of the chamber and the gun platform. These cages are so arranged that the projectile is always in line with the bore of the gun when it is raised sufficiently to abut against stops carried on the oscillating part of the gun mounting. The projectile can then be rammed home by a chain rammer, which is also carried on the gun mounting. This rammer, being flexible in one direction and rigid in the other, cannot consequently buckle up when being extended. It is operated by the revolving of a sprocket wheel, to which it is geared, the tail end of the chain being supported conveniently in a casing carried below the gun slide. The rammer is provided with a safety apparatus so arranged that it cannot be worked until the cage is in the loading position, while the latter cannot be lowered until the rammer has been withdrawn. For hand-loading the rammer head can be lowered clear of the bore of the gun, and the projectile, which is carried on a telescope bogie, can, after being pushed forward on it, be rammed home by an ordinary rammer stave."

A description of the trials of the guns is given in a note under the head of GUNS: FIRING.

INSTRUMENTS USED FOR NAVIGATION AND BATTLE.

NOTE.—Under this head will be given notes on searchlights, range finders, stadimeters, torpedo directors, etc.

DAVIS AND WEAVER RANGE FINDERS: REMARKS.—"The design of Lieutenant Cleland Davis, U. S. Navy, for a horizontal base range finder has been favorably reported upon by the ordnance board of the Army. The instrument consists essentially of a bar about 15 feet long pivoted upon a pedestal in the centre, having at one end a telescope at right angles to the bar and at the other end a fixed telescope slightly inclined to the perpendicular. The range is read from the second telescope upon objects within its field of view. The Army telescope sight with vertical and horizontal scales, which was suggested by Captain E. M. Weaver, artillery corps, has been prepared at the Frankford Arsenal and is now awaiting test at the Sandy Hook proving ground."—*Army and Navy Register*, February 15, 1902.

NEW COMPASS CARD: REMARKS.—"Rear Admiral R. B. Bradford, U. S. Navy, chief of the bureau of equipment, Navy Department, again calls attention in his recent annual report to the proposed change in the present notation of the compass card. The interest in the proposed change continues in the merchant marine as well as in the naval service. The weight of opinion of naval officers is decidedly in favor of the change. The officers of the merchant marine display much interest in the question by frequent discussions of the subject with naval officers in charge of branch hydrographic offices. The universal practice of the officers of the large and important trans-Atlantic steamers is to set the courses steered and record the bearings taken in degrees on the compass card, so that the old practice of using the points of the compass, or fractions thereof, may be considered as abandoned in ships of high speed. In order to maintain an interest in the subject and to encourage further discussion, Admiral Bradford publishes in his report two designs for the new compass card. In his report of last year was published the first of these designs, with a full discussion of the advantages to be obtained by its use. This design met with some objections, as it abolished entirely the use of the compass points to which many mariners are much wedded. The second design has been prepared to meet these objections, and has, in addition to a division of the circumference of the card into 360 degrees, the following subdivisions:

"(a) Immediately inside the graduated circle the card is marked in points and their subdivisions as in the present system of card notation.

"(b) A second circle is drawn inside the points and is graduated in degrees from 0 degrees at north and south to 90 degrees at east and west. Each fifth and tenth degree mark is distinguished by a heavy line. On this circle, also, each compass point is marked by a figure indicating the number of degrees corresponding to it, according to the present notation or system of conversion of points into degrees.

"It may be further stated that both the present and the proposed systems of graduation are used on this card, which will make it valuable for

use by all navigators, and which will afford a ready means of determining practically which compass card possesses the greater value. Most navigators agree that all courses should be set in degrees of the compass card, and the chief point at issue between navigators using modern methods is whether the card should be divided with degrees of quadrant, from 0 degrees at north and south to 90 degrees at east and west, as at present, or whether the circle should be marked continuously to the right from 0 degrees at north to 360 degrees at the starting point. Some mariners also object to recording the directions of the wind in degrees, and are wedded to the old custom of using the points."—*Army and Navy Register*, December 14, 1901.

OPERATIONS: WAR.

NAVAL FIGHT AT PANAMA.—Captain William W. Mead of the cruiser Philadelphia, who witnessed the recent naval battle off Panama, arrived at New York lately on the steamer Orizaba from Colon. In talking of the battle the captain said: "The Lautaro was at anchor in the bay and was surprised early in the morning of January 20, by the liberal gunboat Almirante Padilla. The whole thing was over in a half an hour, although the firing lasted only about fifteen minutes. The Padilla opened fire on the other vessel, bow on and the Lautaro was only able to use her forward and one of her quick firing guns. The two ships were only about 400 yards apart and every shot that the Padilla fired seemed to take effect. The aim on the government boat was not so good and she seemed to be shorthanded. Two other ships in the harbor, the Nanen and the Chiquito, also took part in the fight, but neither did much damage. The government boat shifted around until the Philadelphia was directly in line with the firing from the Nanen. I quickly ordered the commander on the government boat to move and he did. When I saw that the Lautaro was sinking I sent a boat over to her, which picked up two men. One of them died on the Philadelphia shortly afterward. The officer in the boat said that the Lautaro had been struck 27 times and a number of shells had gone entirely through the vessel. I heard later of the death of General Alban. He was struck during the first few minutes of the engagement and was taken to his stateroom. The general went down with the ship. After the fight was over, I sent word to General Herrera, who I thought was in command of the Padilla, and told him that I would oppose any bombardment of the city. The Padilla came alongside and I found that Captain Danivez was the commander. He assured me that no bombardment would take place and that none of the foreign shipping would be endangered."—*Army and Navy Register*, February 15, 1902.

SMALL ARMS.

U. S. ARMY RIFLE, NEW MODEL.—"A new small arm has been devised by officers of the ordnance department of the Army, and the manufacture of 5000 of them will be commenced at the Springfield Armory as soon as the tools at that place are altered so as to be adapted to making

the various parts of the piece. The piece combines the best characteristics of the Krag and the Mauser, although it resembles the latter more than the former arm. The new arm is of .30 caliber, and has a velocity of 2300 feet—200 feet greater than the Krag and 100 feet greater than the Mauser. The bolt in the new arm is made stronger than in the old pieces, to withstand the increased pressure incident to the increased velocity; the new arm loads with a clip from above; and the magazine is centrally and symmetrically located, instead of on the side as before. A rod bayonet is provided with the new arm."—*Army and Navy Register*, January 18, 1902.

McCLEAN SEMI-AUTOMATIC RIFLE.—"According to General Joseph Wheeler, who has made a statement to the U. S. press, a new company is to be formed in the United States, with a capital of $6,000,000, for the purpose of manufacturing rifles, shot-guns, and one to three inch guns in connection with recent developments of the Cramp Shipyard. Apparently, however, the chief energies of the Company will be directed towards the production of rifles for the army and navy services, which General Wheeler, who has had considerable experience in Cuba and the Philippines, considers to be very poorly equipped at present. In fact, he states definitely that the American army rifles are decidedly inferior to those carried by the Spaniard and the Filipino insurgents. The Company now about to be formed will probably adopt as its leading manufacture the rifle invented by Mr. S. N. McClean, of Cleveland, Ohio, for which a record is claimed of twenty-five shots per second. It is on the semi-automatic system, the gas from the first discharge ejecting the fired cartridge, loading a fresh cartridge into the chamber, and so on. Full particulars are not yet available as to the performance and constructive details of the rifle, which have so far been preserved in a condition of strict secrecy."—*Arms & Explosives*, December, 1901.

ROSS STRAIGHT-PULL RIFLE: DESCRIPTION.—This piece, which is the invention of Sir Charles Ross, has been adopted by the Canadian government for the armament of the Dominion troops. The bolt is of the front-lock, straight-pull type, a single rectilinear movement backwards and forwards serving to lock and unlock the breech action and cock the firing pin. The bolt head is separate from the main portion of the bolt, the two parts engaging by means of a series of volute grooves in such a manner that the pushing home of the bolt rotates the head so that the lugs on it enter into corresponding grooves in the housing of the breech. A straight pull upon the bolt lever first causes the bolt head to rotate and free its lugs and then bolt and bolt-head move to the rear together. The extractor is a long piece of steel, spring tempered so as to allow it to snap over the rim of the cartridge, but for extraction it does not rely upon its strength and springiness. On the contrary, the undercut lug laps over the extractor during the withdrawal of the bolt, thereby locking it mechanically against the cartridge case. A strong trigger spring is fitted but it is not absolutely essential to the working of the piece. The sear consists of two parts, one being of the usual bell-crank form working upon a rocking-pin, with an end engaging in the trigger and the other in the usual manner in a detent in the cocking piece for

the purpose of holding back the firing pin in the cocked position. There is another arm on the rocking pin, reaching forward and normally in contact with the under side of the bolt; it is compelled, except when forced out, to act on the sear proper by the pressure of a very powerful spring, so that even were the trigger-blade entirely disconnected, the sear would be compelled to engage with its corresponding detent in the cocking-piece as the bolt was shot forward into locking position. If both sear spring and special sear-spring become inoperative through breakage or other cause the trigger itself solves the difficulty. The back of the trigger-guard is slotted, and the trigger is made of extra depth so that it projects backwards an appreciable distance through this slot. In the natural process of handling the rifle and operating the breech mechanism, the middlefinger of the right hand presses against the right of the trigger guard just at the very spot where there is this projection of the trigger, and that pressure of the finger operating through the trigger to the sear affords at once the missing impulse to engage the sear with the cocking-piece. The magazine is of compact form and kept flush with the woodwork forward of the trigger guard. It consists of a metal box into which the cartridges, five in number, can be dropped haphazard on a platform depressed for that purpose by hand, the arrangement of the cartridges in proper zig-zag fashion ready for use being accomplished automatically or, at worst, assisted by a slight shaking of the platform. A clip or charger may be used if desired. The platform is held up by a z-shaped spring and is depressed by one of the fingers of the left hand (which holds the piece) pushing down on a projection on the right side of the platform extending slightly beyond the woodwork. The wooden casing underneath the barrel is in one piece with the stock and extends nearly to the muzzle, and a top piece joins it about the rear sight, so that the barrel is covered in with wood from the lower band to a point just in front of the face of the barrel. In a competitive trial with the Lee-Enfield, fifty rounds were fired from the Ross rifle with ease in 2 min. 10 sec., while it required 4 min. 40 sec. to fire the same number of rounds from the Lee. The trial of the Ross rifle previous to adoption by Canada was of a very rigorous nature. The tests were modeled after those of the U. S. Army Board and had additional requirements, but the rifle was declared satisfactory in every respect.—Chiefly from *Arms & Explosives.*

HYLARD AUTOMATIC RIFLE.—"A new rifle, the invention of Mr. John Hylard of Melbourne, Australia, was shown last Monday at the Staines Range. In this rifle there are several features which are both new and valuable. The striker is almost entirely contained within the bolt, the only projecting part being the fine point which hits the cap in the cartridge, and its projection is less than ⅛ in. There is thus no danger of the striker being bent and rendered useless if the rifle should be dropped on rocky ground. There is no coiled spring around the striker; it receives its energy from a hammer, operated by a flat spring, both hammer and spring being within the lock. This spring is bent to its acting position when the bolt is rotated previous to withdrawal, and is locked in that position until the bolt is returned to close the breech. Until that action is accomplished, the rifle cannot be fired. Thus the effort required to cock the gun is made during the unlocking of the bolt,

and not during the time it is being returned to the breech, as in the Lee-Metford rifle. It is stated that this renders it possible to load and fire continuously out of the magazine without removing the weapon from the shoulder. The magazine takes five cartridges. The bottom can be removed for cleaning, while the piston, which pushes up the cartridges, can be thrown out of action by a lever, which releases a spring in the lock. The effect of this is that the cartridges can be dropped into the magazine, and do not require careful individual insertion as in the Lee-Metford. They may be carried in any way; in bandoliers or pouches, but it is preferred to carry them in a bandolier fitted with metallic clips which hold five each. These clips are held over the magazine, and the contents pressed out most readily. It is not possible to describe the mechanism of the lock without drawings, but its chief merits are that it has no projecting striker, that the cocking is done on the unlocking of the bolt, and that the bolt cannot fall out when the rifle is carried on a galloping horse. The rifle is being made by Messrs. Bland and Sons, King William-street, Strand, W.C. Last Monday a number of trials were made of the speed of firing aimed shots against a Lee-Metford rifle, with the general result that the new rifle only required about two-thirds of the time of the regulation weapon. Possibly part of the gain should be credited to the marksman."—*Engineering*, London, November 15, 1901.

Brodie Automatic Pistol.—Mr. N. E. Brodie, at present residing in China, has patented an automatic pistol in which the whole of the working parts are enclosed within the outside casing. The weapon is hammerless, and the mechanism is worked by the recoil in a manner similar to that in other pistols of the automatic type. A special sighting device is also attached to the pistol, the sights, both fore and rear, being adapted to lie flat in grooves cut upon the barrel. By this means they are protected. The British patent is No. 10,391 of 1900, and was accepted September 6, 1901.

Mars Automatic Pistol.—This arm is of the recoiling barrel type, and the magazine containing ten cartridges is in the handle, as in the Borchardt and Luger pistols. Underneath the barrel there is a groove or slot of circular section extending from near the muzzle to a point above the trigger guard. The top of this groove is open so as to allow a lug on the barrel to travel in it. The groove contains a long spiral spring extending the whole length (when uncompressed), and in its rear end a small stiff spring surrounding a buffer. When the barrel recoils it compresses the long spring and operates the breech mechanism; its remaining force is received on the buffer. The breech block is carried to the rear by the recoil of the barrel and in so moving stretches two spiral springs held around small guide rods. When the barrel moves to the front under the action of the long spiral spring pressing against the barrel lug it takes the breech block with it for the first quarter of an inch, but during this amount of travel the breech block is disengaged from the breech and the barrel then moves forward alone. The locking lugs and spaces on the front end of the breech block (or breech bolt) are each three in number equally spaced about the periphery of the block, and resemble the lands and blanks of an interrupted screw breech plug for large guns, except that the lugs are not threaded. As the forward movement of the barrel uncovers the loading hole from the magazine

the empty shell is extracted by the extractor and a fresh cartridge, which has been previously drawn to the rear out of the top of the magazine, is now pointed upward fair for loading, its point striking the empty shell and throwing it out. Then the breech block moves forward, loads the cartridge and locks its lugs in the grooves of the breech. Pulling the trigger now fires the piece. In the movement of the barrel and mechanism to the rear a hammer pivoted just below the rear end of the breech block (when closed) is thrown back and held in the cocked position. The firing pin is always held back by its spring except when struck by the hammer which is tripped by pulling the trigger. The pistol is made in three sizes, calibers of .334, .360, and .450. The barrel is very long in proportion to the total length of the pistol. The magazine is charged by a case which can be quickly inserted in the handle so that a speed of 24 shots in 10 seconds has been made. The .360 caliber weapon has a total length of 9.5 inches (11.5 inches open) and a barrel of 8.7 inches; and its weight is 2 lbs. 10 oz. The bullet is nickel-coated, weighing 160 grains; powder charge, 12 grains; muzzle velocity, 1640 f. s.; penetration in 1-inch deal boards, 12 inches. The Mars pistol is the invention of Mr. Hugh W. Gabbett-Fairfax, an Englishman, and is being exploited by an English company.

TORPEDOES.

TORPEDO TUBES NOT TO BE PLACED ON NEW ARMORED SHIPS.—The Naval Board on Construction has refused to reconsider the question of abolishing under-water torpedo tubes in the new battleships and armored cruisers, and the Secretary of the Navy has approved their recommendation that no tubes be placed on the new armored ships.

TRIALS OF TORPEDOES WITH AIR-HEATING APPARATUS.—"In a paper read before the American Society of Naval Engineers and Marine Architects, Mr. F. M. Leavitt records the results of a longer series of observations on the power consumed in propelling Whitehead torpedoes. The experiments in question were made at the works of the E. W. Bliss Company, who supply the United States Navy. Three types are used, all being 45 centimeters in diameter, but differing in length, the short torpedoes being 3.55 meters long, and the others 5 meters long. The air for driving them is stored in steel flasks at a pressure of 1350 lbs. to 1500 lbs. per square inch; the amount of air carried weighing 48 lbs. in the case of a short torpedo, and 80 lbs. in the case of a large one. The engines are of the three-cylinder Brotherhood type, and the air is supplied to these at a constant pressure through a reducing valve. By adjusting this valve, the charge of air can be used either to propel the torpedo at a high speed for a short distance, or at a lower speed for a longer one. The power developed was measured by a modification of the device used by Professor Unwin in his experiments on fluid friction, made some twenty years or so ago, and described in the *Proceedings of the Institute of Civil Engineers*. The propellers of the torpedo were replaced by four discs, each 2 ft. in diameter, which were revolved in a vessel of water concentric with them, and, save for the action of a spring balance, free to rotate about the same center as the discs. The friction of the water set in motion by the discs was measured by the pull on the

spring balance, and this gave at once the torque, and hence finally the horsepower exerted. Between each pair of the moving discs was another, attached to the circumference surface of the containing vessel. The following table shows the average results obtained from a large number of trials:

Type of Torpedo.		Range in Yards.	Pressure in Air Flask Pounds per Sq. In.	Weight of Air Used on Run.	Total Work done on Shaft.	Speed.	Horsepower on Shaft.	—
Length.	Mark.							
m.				lb.	ft.-lb.	knots.		
3.55	I. & II.	800	1350	30	750,000	26.66	25.6	Air cold
5	I.	800	1350	42.3	1,057,000	27.52	37.2	"
5	II.	800	1500	44.5	1,112,500	28.54	40.6	"
5	II.	800	1500	51.6	1,806,000	33.5	77	Air hot
5	II.	1500	1500	62	1,550,000	23.5	24.4	Air cold
5	II.	1500	1500	63.4	2,219,000	27.6	41.9	Air hot

In the experiments with hot air the torpedo was fitted with a re-heater, burning liquid fuel, which warmed the air before it entered the cylinders."—*Engineering*, January 3, 1902.

FLOODING OF UNDER-WATER TORPEDO ROOM ON THE SANSPARIEL.—"A curious accident has happened to the Sanspariel. When using her submerged tubes one of them failed to close after the torpedo left the tube, and in consequence the submerged room was flooded. Several hundred tons of water entered the compartment and submerged the ship's bow about 3 ft. This is rather more sinkage than the theory of things allows for; on the other hand, there is, or was, an impression that the filling of this compartment would capsize the ship. This did not happen, and the water was pumped out by the ship's own appliances without difficulty. But the incident suggests what might very well happen in action."—*Engineer*, London, December 13, 1901.

This explanation of the accident is evidently incomplete. Why was not the inner door of the tube closed? It seems as if some one opened the rear door of the tube without screwing down on the gate; or perhaps the gate is supposed to be self-closing and cannot be operated by hand.

BURSTING OF AN AIR-FLASK OF A TORPEDO ON THE JAUREGUIBERRY.—While she was practicing in the Gulf of Juan, on January 22, the air-flask of one of the Jaureguiberry's torpedoes burst with great violence, wounding several men, one of them dangerously. The four men of the torpedo crew were at their stations and handling a torpedo with its air-flask at 80 atmospheres (1176 pounds per square inch) when the latter burst into several pieces which were driven violently about the compartment. The strong rush of air from the broken flask threw the men about with great force and may have added to their injuries, but

upon this point there is no information. The torpedo which burst was of 450 millimeters caliber and the full charging pressure for launching is 90 atmospheres (1323 pounds per square inch). While only charged to 80 atmospheres at the time of explosion it would have been charged to 90 before being launched, though probably the explosion would have been no more serious. The injury to the ship and fittings by the explosion was trifling. This is not the first time that an air-flask has burst on the Jaureguiberry. About the time she first joined the fleet an air-flask of a torpedo in a submerged tube burst, owing to the jamming of the guide stud, which was either torn out or broke the shell of the flask in its vicinity. The injury in that case was wholly confined to the ship and tube.—Chiefly from *Le Yacht.*

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DECEMBER 27, 1901. The American Steel Industry. Warship Building in 1901. Electrically Driven Centrifugal.

JANUARY 3, 1902. Japanese Shipyards. Shipbuilding and Marine Engineering in 1901. Towing Seagoing Lighters. The Steamboat Equipment of Warships.

JANUARY 10, 1902. Shipbuilding and Marine Engineering in 1901. The Steamboat Equipment of Warships.

JANUARY 19, 1902. Shipbuilding and Marine Engineering in 1901.

JANUARY 24, 1902. Panama or Nicaragua. Wireless Telegraphy. The Boilers of the New British Warships. Dynamo Testing at the English Electric Manufacturing Company's Works. The Parsons Steam Turbine.

JANUARY 31, 1902. Steelmaking in Japan. Small Tube-Boilers for Large Vessels. Beardmore Armor Plates.

FEBRUARY 7, 1902. Japanese Battleship Mikasa. Boilers in the Navy. British and Foreign Shipbuilding. The Steamboat Equipment of Warships.

FEBRUARY 14, 1902. The New Bermuda Floating Dock. Steam Engine Trials. Submarine Telegraph Enterprise. Boilers in the Navy. The Welin Boat-Lowering Gear.

FEBRUARY 21, 1902. Positive Feed Crankpin Lubricator. The Navy Estimates. The Navy Boilers. The Metric System in America.

FEBRUARY 28, 1902. Water-Tube Boilers. The Armored Cruiser Good Hope. Debate on the Navy Estimates. On Explosions of Steam Pipes due to Water-Hammer.

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DECEMBER, 1901. The New French First-Class Battleship Charlemagne. The Transvaal War: Its Lessons in Regard to Militarism and Army Reorganization. Typhoid the Destroyer of Armies, and its Abolition. India: Its Fighting Races and Its Army.

JANUARY, 1902. New Russian First-Class Battleship Retvizan. Cycling as an Aid to Home Defence. From Japan to

Europe by the Trans-Siberian Route. The Water-Tube Boiler Question in the German Navy. The Netherlands' South African Railway Company and The Transvaal War.

PROCEEDINGS OF THE ROYAL ARTILLERY INSTITUTION.

NOVEMBER and DECEMBER, 1901. Contrasts in the Conditions of Warfare at the Beginning of the Nineteenth and Twentieth Centuries and Some Deductions as to Possible Tactical Formations for the Future. An Old Table of Ordnance. Recent Development of Field Artillery Materiel on the Continent. Germany. Thoughts on Coast Defence Suggested by the Boer War. Boer Position on the Tugela, 1899.

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DECEMBER 7, 1901. The Mercantile Marine: French and Foreign. The Russian First-Class Battleship Retvizan. The New Regulations for the Mercantile Marine.

DECEMBER, 14, 1901. A New Torpedo Boat Station at Lezandrieux.

DECEMBER 21, 1901. Naval Mechanics. The English First-Class Armored Cruiser Cressy. The Mercantile Marine: French and Foreign.

DECEMBER 28, 1901. What Type to Adopt for Ships of War. The Question of the Cadres. The Russian Coast-Guardship Rotislav. The Pendulum Propeller. Recruiting for the German Mercantile Marine.

THE ENGINEER.

NOVEMBER 22, 1901. Gun Explosions. The Jubilee of Submarine Telegraphy. High-Speed Double Compound Engine. H. M. First-Class Cruiser Monmouth. The Hylard Rifle Mechanism. Danish Merchant Steamer Oscar II.

NOVEMBER 29, 1901. A Fast Torpedo Destroyer. Russian Battleship Kniaz Polekin Tavritchesky. Indian Coal. Engineers in the United States Navy. The Admiralty Committee on Torpedo Destroyers.

DECEMBER 6, 1901. The French Mercantile Marine. A New Automatic Pistol. Shipbuilding on the Clyde.

DECEMBER 13, 1901. The Aesthetic Principles of Naval Architecture. Electric Lighting American Shipping. A new System of Gun Disposition.

DECEMBER 20, 1901. A New Oil Gas Generator. Aluminum in The Electrical Industries. The Steel Plate Combination. Wireless Telegraphy Across the Atlantic.

DECEMBER 27, 1901. Progress of Warships and Machinery Building in England. A Big Duplex Lathe. The Wing Propeller Fan. Russia's Mercantile Marine. German Cruiser Konig Wilhelm Ersatz. United States Warships. Our Naval Needs. A New Speed Counter.

JANUARY 3, 1902. A Comparison of Recent Battleship Designs. The New Deep-Water Dock at Cardiff. The Steamboat Equipment of Warships.

JANUARY 10, 1902. Shipbuilding and Marine Engineering During 1901. The Japanese Battleship Mikasa. How Should Steel for Girders be Tested? The French Navy in 1901. The Great Coal Question. Cordite. Repairing Worn Out Guns on Service.

JANUARY 17, 1902. Tests of High-Explosive Shells. New Government Iron and Steel Works in Japan. Shipbuilding and Marine Engineering During 1901. The Training of Engineering Apprentices. High-Speed Steam Engines.

JANUARY 24, 1902. Shipbuilding and Marine Engineering During 1901. The Japanese Cruisers Niitaka and Tsushima. The Color of Warships. Boilers for the Navy.

JANUARY 31, 1902. Blake's Improved Multitubular Vertical Boiler. The German Navy in 1901.

FEBRUARY 14, 1902. The Russian Navy in 1901. The Torpedo Accident on Board the French Battleship Jaureguiberry. Torpedo-Boat Destroyers for the Japanese Navy. Triple Expansion Engines, United States Navy. Floating Dock for Bermuda.

FEBRUARY 21, 1902. Notable Shipbuilding Abroad. The Navy Estimates.

FEBRUARY 28, 1902. The Development of the United States Navy. The Naval Estimates. Mr. Arnold Forster and The Naval Engineers. The Russian Battleship Pobieda.

UNITED SERVICE GAZETTE.

JANUARY 4, 1902. Yeomanry and Volunteers. Volunteers and Coaling Stations. The New Army Musketry Course. Volley-Firing Abandoned. Seamen in South Africa. The Transvaal War.

JANUARY 11, 1902. Yeomanry and Volunteers. Lifeboat Service in 1901. Colonies and Imperial Defence. The Transvaal War. Losses at the Front.

JANUARY 18, 1902. Yeomanry and Volunteers. The Colonies and Imperial Defence. 1. Interview with Sir John Colomb, K. C. M. G., M. P. Where Germany Threatens Russia. The Proposed Naval Volunteer Reserve. An Australian Navy.

The Transvaal War. The Japanese Battleship Mikasa. Reorganization of the Infantry Volunteers.

FEBRUARY 1, 1902. The Colonies and Imperial Defence, III. Yeomanry and Volunteers. The Faults of the Bayonets and Butts of the New Russian Magazine Rifle. The Blockhouse in South Africa. Military Ballooning. South African Situation.

FEBRUARY 8, 1902. The Colonies and Imperial Defence, IV. The Army Medical Service. Newfoundland and the Naval Reserve.

FEBRUARY 15, 1902. The Colonies and Imperial Defence, V. Street Fighting. Military Tactics. Wei-hai-wei and Japan. Naval Engineers. The Transvaal War.

FERBUARY 22, 1902. The Colonies and Imperial Defence, VI. The Boer as a Soldier. The Army Estimates. Navy Estimates.

ANNUAL REPORT OF THE SECRETARY AND TREASURER OF THE U. S. NAVAL INSTITUTE.

To the Officers and Members of the Institute:

Gentlemen:—I have the honor to submit the following report for the year ending December 31, 1901:

Itemized Cash Statement.

Receipts During the Year 1901.

Items.	First Quarter.	Second Quarter.	Third Quarter.	Fourth Quarter.	Totals.
Dues	$206 47	$228 00	$982 25	$632 76	$2049 48
Subscriptions	133 21	292 40	107 95	107 05	640 61
Sales	127 19	96 88	39 77	99 00	362 84
Advertisements	76 25	70 00	240 00	220 00	606 25
Interest	144 94	9 00	54 50	68 31	276 75
Binding	1 00	1 80	15 60	6 00	24 40
Premium on money orders	..	06	05	05	16
Life membership fee	..	30 00	30 00	30 00	90 00
Totals	$689 06	$728 14	$1470 12	$1163 17	$4050 49
Receipts from extra publications					3612 79
Total					$7663 28

EXPENDITURES DURING THE YEAR 1901.

Items.	First Quarter.	Second Quarter.	Third Quarter.	Fourth Quarter.	Totals.
Printing and Binding	$50 28	$1248 13	$572 11	$409 86	$2280 38
Salaries	300 00	300 00	315 00	345 00	1260 00
Postage	43 50	38 17	63 42	44 03	189 12
Expressage	8 62	4 55	3 73	4 90	21 80
Cost of articles	110 00	98 90	145 00	263 00	616 90
Stationery	65	5 24	38	45 64	51 91
Purchase of text-books	14 56	1 35	90	18 99	35 80
Freight and hauling	4 50	3 67	5 91	9 35	23 43
Discount on checks	76	64	1 23	2 60	5 23
Telegrams	1 95	50	25	..	2 70
Office expense	1 65	1 00	8 30	10 75	21 70
Prize essay and medal	123 51	..	..	..	123 51
Purchase of back Nos.	..	1 25	..	..	1 25
Rent of safe box	..	5 00	..	..	5 00
Insurance	..	..	36 00	..	36 00
Sub. Navy and Marine Corps Directory	..	..	5 00	..	5 00
Furniture	..	..	..	85 70	85 70
Totals	$659 98	$1708 40	$1157 23	$1239 82	$4765 43
Paid for printing and binding extra publications					1369 85
Total					$6135 28

SUMMARY.

Balance of cash unexpended January 1, 1901	$3713 51
Total receipts for 1901	7663 28
Total available cash, 1901	$11,376 79
Total expenditures, 1901	6135 28
Cash unexpended January 1, 1902	$5241 51
Held to credit of reserve fund	389 14
True balance January 1, 1902	$4852 37
Bills receivable for dues, 1901	837 85
" " " back dues	808 00
" " " binding	27 00
" " " subscriptions	130 40
" " " sales	145 82
" " " advertisements	325 75
Value of back numbers, estimated	925 00
" " Institute property	180 00
" " extra publications	2300 00
	$10,532 19
Liabilities for publications other than PROCEEDINGS	411 51
Total assets exclusive of reserve fund	$10,120 68

Reserve Fund.

United States 4 per cent consols, registered	$900 00
District of Columbia 3.65 per cent registered	2000 00
" " coupon bonds	650 00
	$3550 00
Cash in bank uninvested	389 14
Total	$3939 14
Number of paper bound copies of the Proceedings on hand at the end of the year	9908
Number of cloth bound copies	1554
Total	11462

Very respectfully,

L. S. Van Duzer, *Lieutenant, U. S. Navy,*

Secretary and Treasurer.

OFFICERS OF THE INSTITUTE.

President.

REAR-ADMIRAL WILLIAM T. SAMPSON, U. S. NAVY.

Vice-President.

COMMANDER RICHARD WAINWRIGHT, U. S. NAVY.

Secretary and Treasurer.

LIEUTENANT L. S. VAN DUZER, U. S. Navy.

Board of Control.

Commander C. E. COLAHAN, U. S. Navy.
Lieutenant-Commander J. P. PARKER, U. S. Navy.
Lieutenant-Commander J. E. CRAVEN, U. S. Navy.
Lieutenant-Commander JOHN HOOD, U. S. Navy.
Professor P. R. ALGER, U. S. Navy.
Professor N. M. TERRY, A. M., Ph. D.
Lieutenant L. S. VAN DUZER, U. S. Navy (ex officio).

SPECIAL NOTICE.

NAVAL INSTITUTE PRIZE ESSAY, 1902.

A prize of one hundred dollars, with a gold medal, is offered by the Naval Institute for the best essay presented on any subject pertaining to the naval profession, subject to the following rules:

1. The award for the prize shall be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors.

2. Each competitor to send his essay in a sealed envelope to the Secretary and Treasurer on or before January 1, 1903. The name of the writer shall not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary and Treasurer, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Board.

3. The successful essay to be published in the Proceedings of the Institute; and the essays of other competitors, receiving honorable mention, to be published also, at the discretion of the Board of Control; and no change shall be made in the text of any competitive essay, published in the Proceedings of the Institute, after it leaves the hands of the Board.

4. If, in the opinion of the Board of Control, the best essay presented is of insufficient merit to be awarded the prize it may receive "Honorable Mention" or such other distinction as the Board may decide.

5. Any essay not having received honorable mention, may be published also, at the discretion of the Board of Control, but only with the consent of the author.

6. The essay is limited to fifty (50) printed pages of the Proceedings of the Institute.

7. All essays submitted must be either type-written or copied in a clear and legible hand.

8. In case no essay is awarded the prize, the writer whose essay is first in order of merit will, if his essay has received honorable mention, be made a life member. Additional recognition of the merits of papers may be made by the Board at its discretion.

9. In the event of the Prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of a gold medal.

By direction of the Board of Control.

L. S. VAN DUZER,
Lieut., U. S. N., Secretary and Treasurer.